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THE RISK AND USE OF DERIVATIVES. EVIDENCE FROM EUROPEAN BANKING SECTOR

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Introduction

Bank participation in the market for derivatives has been growing rapidly in recent years. Financial instruments like swaps, futures and options now form an important share of total assets at most of the banks and their impact became increasingly controversial in the last years of the 20th century, up until the recent financial crisis when participation in these markets had accounted for increasing share of bank revenues. Especially, after global financial crisis in 2008, banks' derivative activities have become increasingly debated. In fact, the effect of derivative use on risk measure and value is especially important in banking since banks dominate most derivative markets. Many observers are concerned that derivatives could be too risky for banks, still US Federal Reserve Board Chairman Alan Greenspan sustained that derivatives had contributed to the development of a "far more flexible, efficient and resilient financial system that existed just a quarter-century ago", whereas in contrast, the noted US investor Warren Buffet[1] described some derivatives as "financial weapons of mass destruction."

The aim of this thesis is to deepen understanding of the role of banks in the derivatives market and to analyse and the impact of such instruments on banks performance and risk. The sample of our study consist of European listed banks consisting of the EU-28 countries considering all available data for the past ten years till 2013 and also were included listed banks from Switzerland, Turkey and Russia.

The structure of this paper is organized as follows. Chapter 1 defines derivatives and explains their usage with quick overview of theoretical and regulatory background. Chapter 2 review the core findings of previous literature in the topic of interest. Chapter 3 describes the data, methodologies and sources that are used. Chapter 4 discusses the results of the regression and Chapter 5 presents the outcomes of the research and summarize the conclusions.

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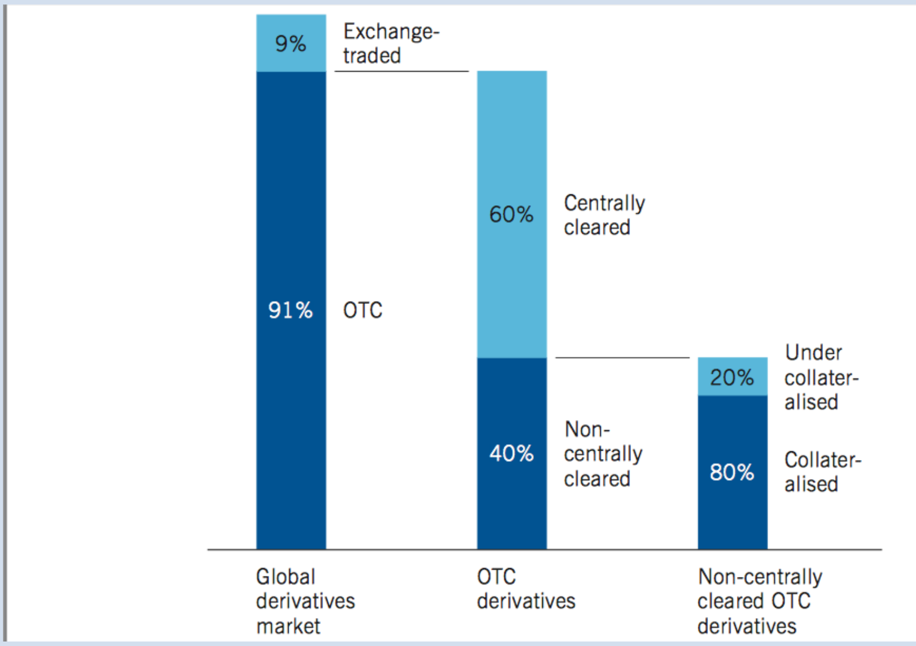
[1] See pp. 13-15 of Berkshire Hathaway's 2002 annual Report at **www.berkshirehathaway.com/2002ar/2002ar.pdf.**

Chapter 1. Derivatives market. An overview.

1.1. *Derivatives definition*

Derivatives are financial contracts whose values depends from the values other underlying assets, such as interest rates, bonds, foreign exchange, commodities, equities or index of asset values. This financial instruments that are mostly used to manage risks and protect against different exposures, but also very often serve investment and arbitrage purposes, giving numerous advantages compared to securities.[2]

Graph 1: Global derivatives market, OTC vs On-exchange June 2013



Source: Eurex Clearing, July 2014 [3]

Derivatives with standardised terms of the contracts are traded on organised exchanges, consequently the features of these contracts are not tailored to the needs of individual buyers and sellers. The quoted prices for this category of contracts for the instruments are generally publicly available.

[2] The Global Derivatives Market – An Introduction, Deutsche Börse, 2008
[3] How central counter parties strengthen the safety and integrity of financial markets, Eurex Clearing, July 2014, p-7

In contrast OTC derivatives commonly referred to as over-the-counter are non-exchange traded, usually bilateral and customised to meet the specific needs of counterparties. Such contracts usually have terms of the contracts often tailored to the parties' specific requirements and executed directly between counterparties (including trades carried through CCps)

1.2. *Main types of derivatives a quick overview*

Derivatives have grown in popularity because they offer a combination of characteristics not offered by other assets. Generally we can separate derivatives into three macro categories:

– forward-based

– swap-based

– option-based.

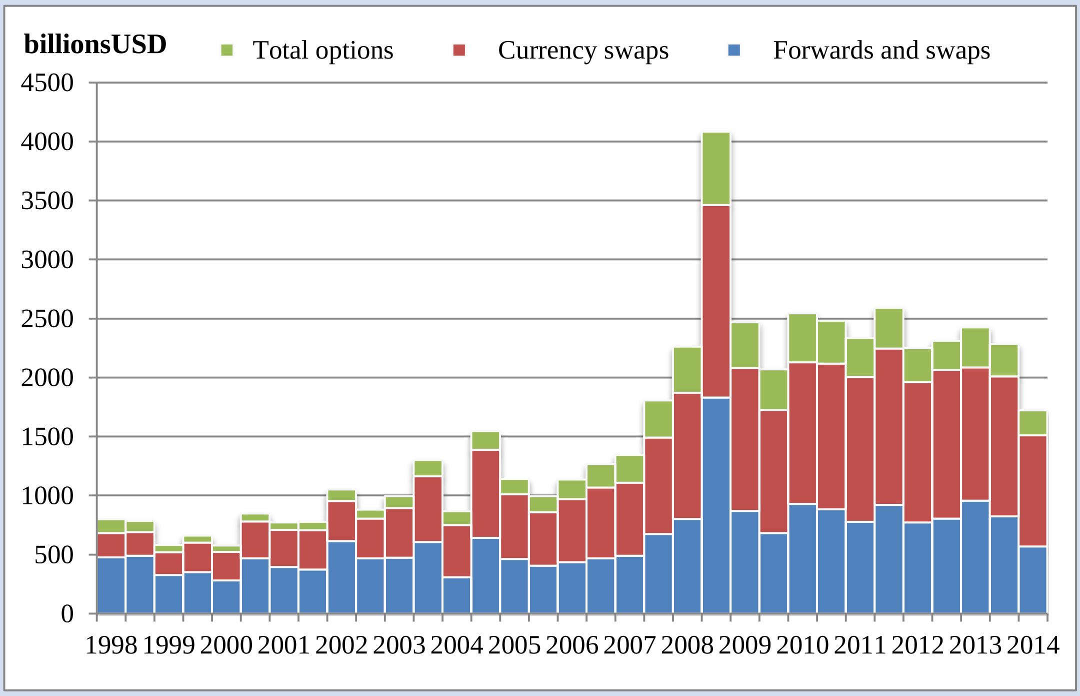
Forward-based derivatives are contracts with a mandatory requirement to settle at a set point in time in the future at a definite price. The agreement stipulates the specific reference rate – for example interest rate or currency exchange rate – the date of settlement and the notional value. A forward contract that is exchange-traded is generally called as a 'futures contract'. Futures are generally based on stock market indices, interest rates, commodities or currencies. OTC forward-based derivatives are in general referred to as 'forward agreements'. The two main categories of OTC forward agreements are based on interest rates and foreign exchange rates.

Swap-based derivatives are the contracts in which counterparties exchange, over a period of time, one stream of cash flows for another stream of cash flows. The streams are usually referred to as 'legs' of the swap agreement. The cash flows are usually calculated with reference to a notional amount, which is often not exchanged by the counterparties – e.g. interest rate swaps. Swap-based derivatives are a type of forward-based derivative because their structure is a series of forwards.

One of the most used swaps are vanilla interest rate swaps, which are mostly traded Over-the-counter. A vanilla IRS is an exchange of a fixed rate stream of cash flows for a floating rate stream calculated on a set notional amount. An interest rate swap may also consist of the exchange of one floating rate stream of cash flows for a different floating rate stream (a basis swap). The term of the interest rate basis to which the floating rate of an interest rate swap resets (e.g. three-month LIBOR), which usually matches the frequency of the reset, is often referred to as the tenor basis of the interest rate.

Option-based derivatives include contracts that give one party the right and not the obligation, to participate in a transaction to buy or sell an asset on a set date or within a set period of time at a particular (strike) price. Options can be exchange-traded or OTC. In the table below we can distinguish market values of contracts by current market values since 1998 exchanged OTC, where Options represent only a small part of total volume.

Graph 2: Foreign exchange derivatives by instrument, gross market 1998 – 2014



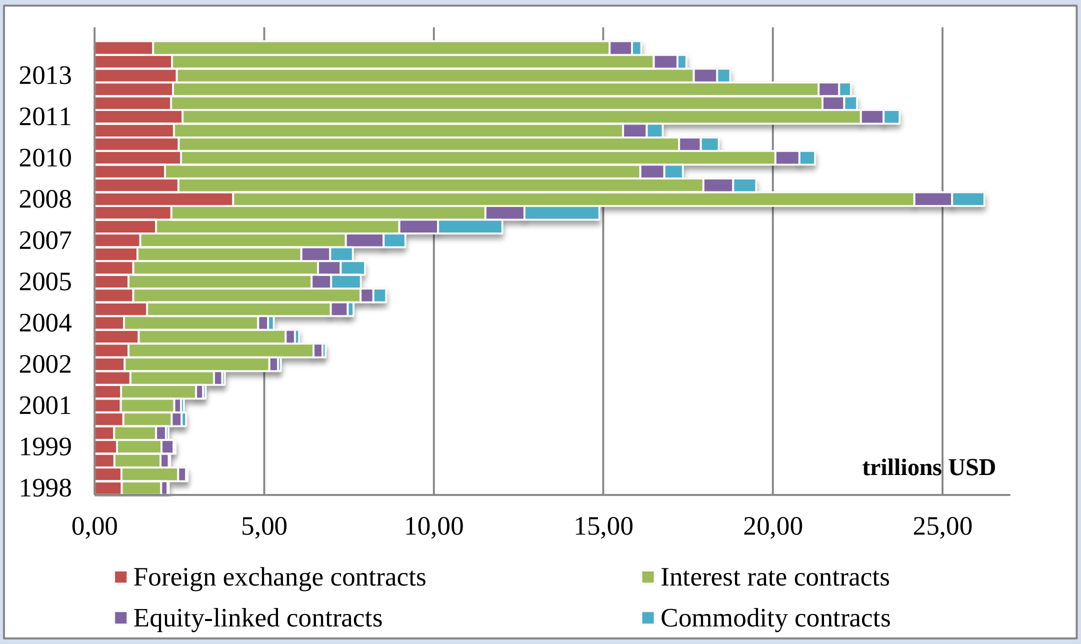
Source: Bank for International Settlements, Derivatives (http://www.bis.org/statistics/derstats.htm)

Furthermore, many derivatives like swaps include various types of option-like features, such as early termination and term extension options, which can make their values behave like option-based derivatives. Option-based features include other terms that give rise to asymmetric exposure to increases and decreases in market variables similar to an option – e.g. an interest rate cap that allows one party to enjoy the benefit of decreases in interest rates, but not the full risk of increases in interest rates.

1.3. *Global OTC derivatives market*

Most derivatives are based on one of four types of underlying assets: foreign exchange, interest rates, commodities, and equities. On the graph we can see the evolution of global OTC derivatives market since 2007, the major part is composed by interest rate derivatives, followed by foreign exchange while equity-linked and commodity contract amounts had been decreasing since 2008 both in gross market value and notional amount due also to their major presence in exchanged markets.

Graph 3: OTC Derivatives gross market values in billions of USD

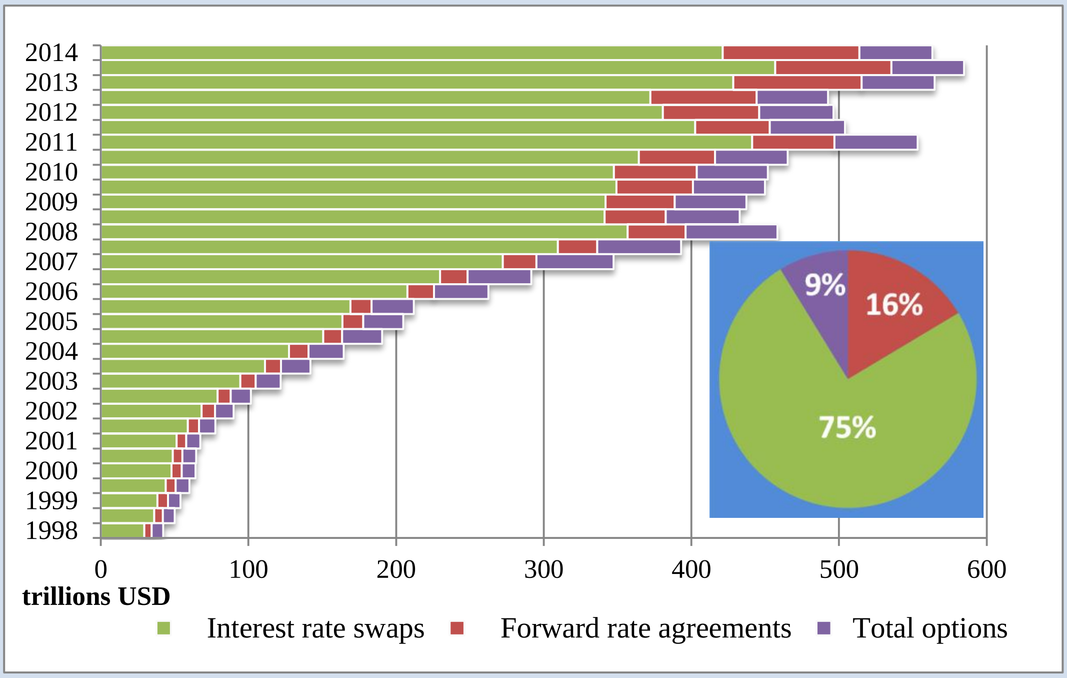


Source: Bank for International Settlements, Derivatives (http://www.bis.org/statistics/derstats.htm)

The derivatives market continues to be the largest single segment of the financial market. From the Table 3 we can analyse the historical evolution and notice that the size of the market increased approximately by 15% per year since 1998 with a peak of 27 trillion USD in gross amount[4] in 2008. However, in the second half the market volume contracted for the first time since 1998, due to the financial and economic crisis as one of the main reasons.

The second largest segment of the global OTC derivatives market is represented by foreign exchange derivatives (FX), after interest rates (see table 3). Particularly if we take in consideration year 2014, the foreign exchange contracts outstanding by notional amounts equalled to almost 75 trillion USD (nearly 12 % of all OTC contracts), while by gross market values the peak of FX derivatives falls on 2008 of approximately 4 trillion USD and decreased in recent years to 2,5 trillion on average.

Graph 4: Interest rate derivatives by instrument, nominal values 1998 – 2014



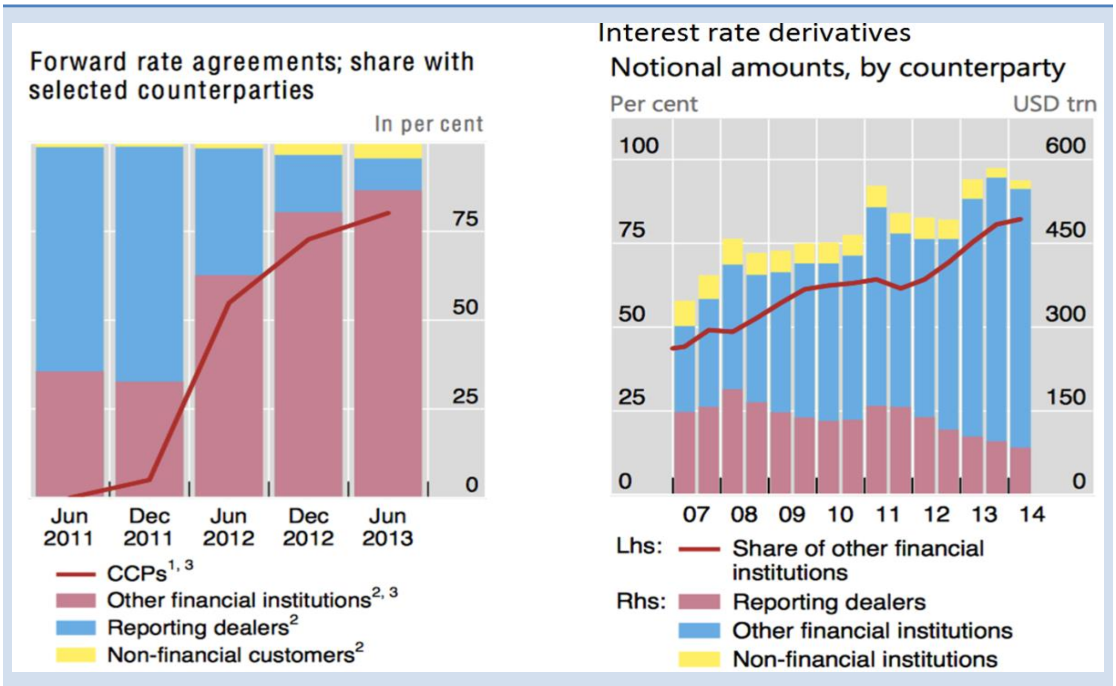
Source: Bank for International Settlements, Derivatives (http://www.bis.org/statistics/derstats.htm)

[4] The term "gross" indicates that contracts with positive and negative replacement values with the same counterparty are not netted.

The major part of OTC derivatives activities had been always represented by interest rate derivatives segment (see graph 3). Starting with the first swap contract in 1981 between IBM and the World Bank today the volume of swap market activity had grown exponentially to reach nearly 429 trillion USD in 2014. If we consider more detailed information, in June 2014 most of interest rate derivatives equalled to $563 trillion in notional amount and were composed by interest rate swaps (IRS) approximately 75 % then forward rate agreements by 16% and total options[5] (9%). Total interest rate derivatives accounted in 2014 for almost 81% of the whole market (see table 3 and 4).

In order to reduce systemic risks in financial markets, one of the central priorities of global regulators' agenda to reform OTC markets is to incentivise market participants to execute most of the transactions through the central clearing utilizing central counterparties CCPs. In particular examining interest rate derivatives by counterparty (graph 5), we can observe a clear trend in reducing of

Graph 5: Interest rate derivatives by counterparty, nominal values



Source: Bank for International Settlements, Derivatives (http://www.bis.org/statistics/derstats.htm)

[5] Total options are given by options bought and sold.

reporting by dealers[6] and non-financial institutions, due to increasing number of transactions centrally cleared by CCPs.

Also considering transactions between active derivative dealers[7], the notional amount of interest rate contracts exchanged was declining almost constantly since maximum level of 2008 from $189 trillion, to approximately $86 trillion in 2014.

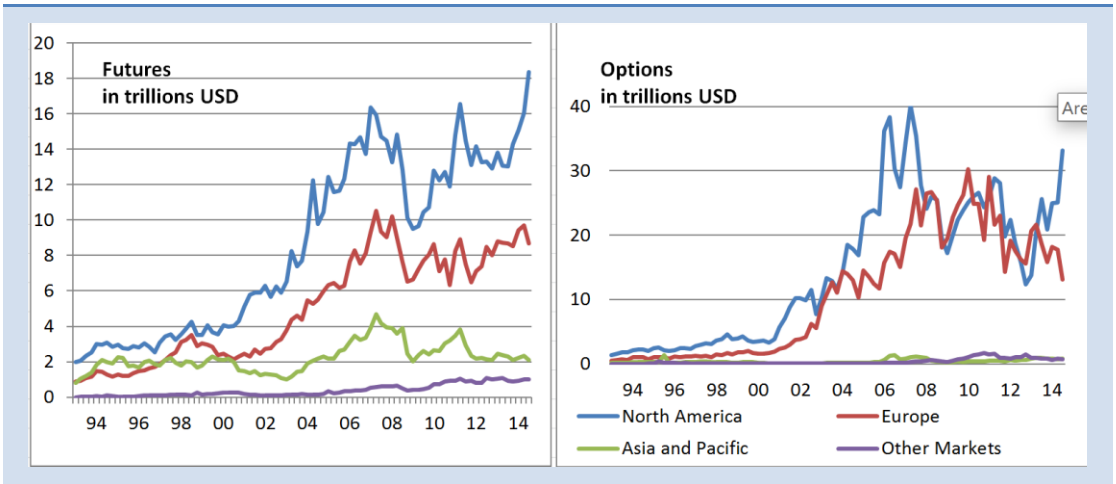
The relative importance of other financial institutions[8] continued to grow in 2014. Their share of all outstanding contracts increased from 49% at 2008 to 82% at 2014. Meanwhile the contracts between other financial institutions (included CCPs) and dealers, remained nearly unchanged in last years, Non-financial customers that are any counterparty other than reporting dealers and other financial institutions are in practice predominantly corporate firms and governments. Their share on notional amounts had been decreasing since 2007.

1.4. *Exchange traded markets*

Both exchange-traded and OTC derivative markets have grown sharply in their sizes since the 2000s and this trend was only temporarily interrupted by the financial crisis. But still the notional amounts outstanding in both markets have returned to almost pre-crisis levels (Graph 6). Total notional amounts outstanding of derivatives traded in OTC markets are several times larger than those on exchanges. The two exchanges, North America and Europe, remain leading with more than 90% of total market share, while the two most popular instruments traded on organised exchanges are interest rate futures and options.

Graph 6: Interest rate derivatives by counterparty, nominal values

[6]The term "reporting dealers" refers to banks (both commercial and investment) or other financial services firms that make reports about their market activities to a central bank or another monetary authority. After this information is utilized to make statistics and help determine monetary policy.
[7] For instance, Bank for International Settlements had been receiving information from G10 central banks about activity in (OTC) derivatives markets reported to them by active dealers since 1998.
[8] Other financial institutions are not classified as reporting dealers, including central counterparties (CCPs), banks, funds and other non-bank financial institutions which may be considered as financial end users, for example mutual funds, pension funds, hedge funds etc.

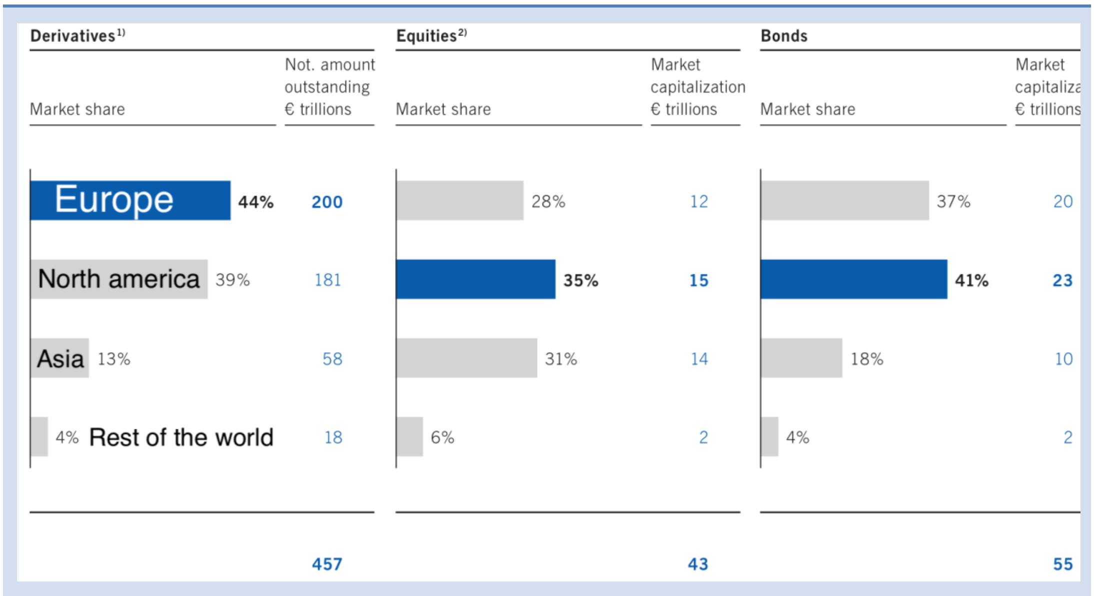


Source: Bank for International Settlements, Derivatives [(http://www.bis.org/statistics/derstats.htm)](http://www.bis.org/statistics/derstats.htm)

1.5. *Evidence on the European market*

The derivatives market had expanded exponentially from 2000s as the benefits from their usage, for instance effective risk transfer and mitigation, have become gradually more important. As from the graph below Europe is key role player by market share in this segment, as derivatives have become an important part of the European financial services sector and a contributor to economic development.

Graph 7: Regional split for OTC derivatives, Notional amount outstanding



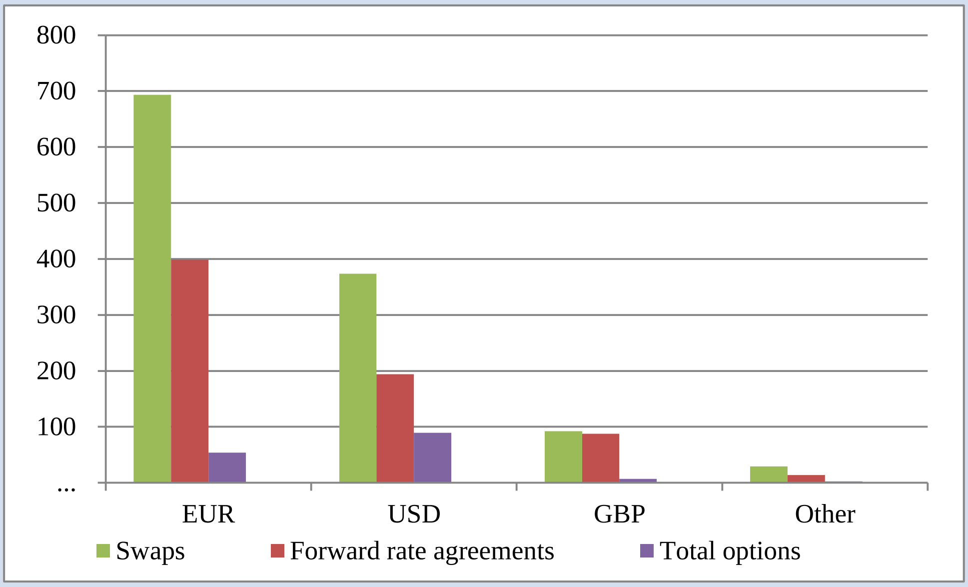
Source: The Global Derivatives, Deutsche Börse, 2008

With near 44% of the total global outstanding volume, the European derivatives market has a considerably higher share compared to its total share of equities or bonds, consequently together North American market it is one the most important region in the global derivatives market. Regarding exchange traded derivatives, both in the US and the EU, commodities, derivatives, futures and options are mainly exchanged on public markets, such as the Chicago Mercantile Exchange (CME)[9] and Eurex.[10] The post-crisis reforms of securities and derivatives trading that were implemented by the European Union (EU) consist of two major policies:[11]

- EMIR;
- MiFID;

The first is European Market Infrastructure Regulation (EMIR), which

Graph 8: OTC interest rate derivatives by currency 2013 in billions USD[12]



[9] <http://www.cmegroup.com/>.
[10] <http://www.eurexchange.com/exchange-en/>
[11] FERRARINI G., SAGUATO P., *"Reforming Securities and Derivatives Trading in the EU: From EMIR to MIFIR"* (January 28, 2014). 13(2) Journal of Corporate Law Studies 319
[12] Bank for International Settlements (2008) and World Federation of Exchanges (WFE) statistics **(www.world-exchanges.org)**.

principally responds to systemic stability concerns. The second, the Markets in Financial Instruments Directive (MiFID) – while taking into consideration systemic stability goals tries to optimize the transaction costs of securities and derivatives trading.

1.6. *OTC Derivatives regulation reforms*

In order to diminish systemic risk, improve transparency in financial markets and prevent market abuse after some concerns about systemic risks in over-the-counter (OTC) derivatives markets were exploited the leaders of G20 countries have decided in 2009 to a comprehensive reform agenda as reported by the FSB[13]. To improve issues connected with OTC markets, participants agreed to take measures in order that:

- all OTC derivatives contracts should be reported to trade repositories (TRs)[14];
- all standardised contracts should be traded on exchanges or electronic trading platforms, where appropriate, and cleared through central counterparties (CCPs);
- non-centrally cleared contracts should be subject to higher capital requirements and minimum margining requirements should be developed.

By the start of 2014 considerable improvement has been made in executing this agenda as most of FSB member jurisdictions plan to have legislation and regulation adopted to require transactions to be reported to trade repositories. Structures for central clearing requirements are already in place in major derivatives markets, with concrete rules now starting to go into execution. Also international standards for bilateral margin requirements and for capital

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[13] Countries members of FSB board: Argentina, Australia, Brazil, Canada, China, France, Germany, Hong Kong, India, Indonesia, Italy, Japan, Mexico, Netherlands, Russia, Saudi Arabia, Singapore, South Africa, South Korea, Spain, Switzerland, Turkey, United Kingdom, United States

[14] Trade repositories (TRs) centrally collect and maintain the records of derivatives. They play a central role in enhancing the transparency of derivative markets and reducing risks to financial stability.

requirements have been proposed or approved, in order to promote sound risk management and encourage use of central clearing. For this purpose main regulators from a number of large OTC derivatives markets have reached agreements to improve the cross-border implementation of reforms in OTC derivatives markets. Some economic studies suggest net long-run benefits from such reforms.[15]

1.7. *Derivatives accounting*

Many studies have analysed derivatives from accounting perspective, in particular fair values of financial instruments held by banks, for example the paper of Venkatachalam[16] (1996) examines the significance of fair value disclosures of banks' derivatives and finds that fair values of derivatives are incrementally related with bank share prices after controlling for the notional amounts of derivatives. But just some of these papers conduct empirical tests on the economic effect of fair value reporting, and the results are limited to firms based in US. Among them two studies can be evidenced. Singh (2004)[17] which studied impact on firms after the adoption of SFAS 133 standard, and the second, Zhang (2009), which examined the effect of the accounting standards for derivative instruments on corporate risk-management behaviour and interpreted the results as confirmation that fair value reporting has reduced speculation and led to more cautious risk management practices.[18]

Up until the broad development of derivatives market, most of financial instruments were accounted for at book values, but this methodology not always reflected the real or market value. But recently according to IFRS, derivative financial assets and liabilities are measured at fair value or as "the price that

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[15] Financial Stability Board, OTC Derivatives Market Reforms. Sixth Progress Report on Implementation, 2 September 2013

[16] VENKATACHALAM M., "Value-relevance of banks' derivative disclosures.", Journal of Accounting and Economics 22: 327-355, 1996

[17] SINGH A., "*The effects of SFAS 133 on the corporate use of derivatives, volatility and earnings management.*", The Pennsylvania State University, 2004

[18]. ZHANG H, "*Effect of derivative accounting rules on corporate risk-management behaviour",* 2009

would be received to sell an asset or paid to transfer a liability in an orderly transaction between market participants at the measurement date". The derivatives are valued at fair value when quoted prices in active markets are available, those amounts are used to evaluate financial instruments. However, because the majority of derivatives have tailor-made terms and are exchanged OTC rather than through exchanges, quoted prices in active markets are frequently not available; consequently banks usually estimate fair values using different valuation techniques. While unrealized gains and losses, different from those used for hedging investments of cash flows, are reported in income.

Usually in banks' balance sheets most of the derivatives are reported as trading, due to the difficulties to meet high criteria for hedge accounting requirements, so costs connected with all unrealized trading derivative gains and losses must be reported in annual income. The same is true for derivatives that are not use as hedging instruments.

A derivative instrument that is designated and qualified for hedging purposes must be categorized according to hedge accounting models. The of model that is applied vary if the hedged exposure is, accordingly: [19]

1) fair value hedge (a change in the fair value of a liability or an asset);
2) cash flow hedge (a variability in cash flows)
3) hedge of a net investment in foreign operations (a currency exposure on an investment in a foreign operation);

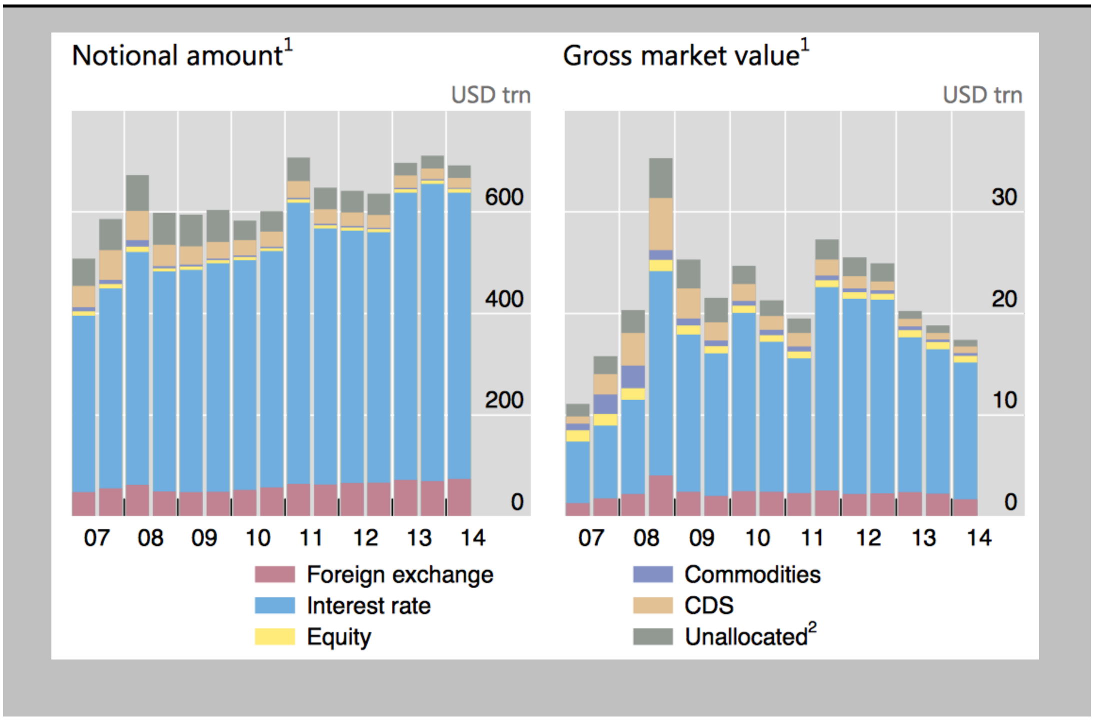
Relative gain or loss on hedge derivatives[20] as the connected gain or loss on the hedged item underlying the hedged risk, are both recognized in earnings during the period of change of the fair value. The effectiveness of hedging[21] depends if the hedged item and the hedging item are correlated. The correlation must be negative, so that the changes in values of cash flow of the hedged item are offset by an opposite change in value or cash flow of the hedging item. Thus,

[19] IFRS Practice Issues for Banks: Fair value measurement of derivatives, KPMG 2012
[20] RAMIREZ J., "*Accounting for Derivatives: Advanced Hedging under IFRS",* Wiley, 2007
[21] KOCON J., "*Hedge accounting in banks in the light of the international financial reporting standards",* Aarhus School of Business, 2007

with a perfect fair value hedge , the change in the fair value of the hedged item will be offset, with no net effect on earnings.

The risk associated with derivatives, securities and other financial instruments is correlated with their notional amounts. But, unlike securities where book value on is comparable to the notional amount, the book value of derivatives when they are recorded using fair value methodology is considerably smaller than their notional amount, so even if in most banks derivatives account for only small share of assets and liabilities, their impact on risk of the bank is significantly larger, especially when banks use derivatives for trading purposes and not to hedge their exposures. For comparison the notional and market prices at the table below. The notional amounts exceed from 20 to 30 times the market values.

Graph 9: Global Over the counter derivatives 2007-2014 [22]



Source: Bank for International Settlements report **(http://www.bis.org).**

[22] Gross market values are defined as the sums of the absolute values of all open contracts with either positive or negative replacement values evaluated at market prices prevailing on the reporting date.

Chapter 2. The Impact of derivatives in literature

2.1. *Non-financial firms*

Though the primary users of derivatives are financial institutions such as banks, insurance companies, and money managers, the use of derivatives by non-financial firms is very significant. A considerable number of studies are focused on impact of derivatives and their usage by non-financial companies. The majority of these studies use samples of U.S. firms principally because of data availability, good quality of disclosures and significant number of companies to study. In this section we summarize me most relevant to our topic to focus ultimately our attention on the studies that examine banking sector.

Some studies of Allayannis and Ofek (2001)[23] provide evidence indicating that derivatives use reduces firms' exchange rate exposures, which as a result increases firm value for non-financial firms. Later Allayannis and Weston (2001)[24] take on a test and find that the value of firm measured by Tobin's Q is much higher for U.S. firms that hedge their foreign exchange exposures with derivatives.

Muller and Verschoor (2005) [25] analyze sample of 471 European non-financial firms to find the main motivation why individual firms use foreign currency derivatives and investigates also what effects this derivatives usage has on the foreign exchange risk exposure. They find significant evidence that firms are more facilitated in hedging in presence of economies of scale, in other words when the firm is larger in size and also the volume of foreign activity is large enough to justify the costs, different hedging programs are more facilitated to be implemented. During their study they mention Smith and Stulz (1985) on the

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[23] ALLAYANNIS, G., and E. OFEK. 2001. "*Exchange Rate Exposure, Hedging, and the Use of Foreign Currency Derivatives*." Journal of International Money and Finance 20: 273-296.
[24] ALLAYANNIS, G., and J.P. WESTON 2001. "*The Use of Foreign Currency Derivatives and Firm Mar- ket Value*." Review of Financial Studies 14:1: 243-276.
[25] MULLER A., VERSCHOOR W., *The Impact of Corporate Derivative Usage on Foreign Exchange Risk Exposure",* March 2005

subject of tax convexity and conclude that European firms make use of hedging due to tax convexity, mainly in order to reduce volatility costs, that are high for firms with convex effective tax functions. Ultimately the authors conclude that European firms use foreign currency derivatives in bigger extent to protect themselves from currency fluctuations rather than to speculate. Even though, these European companies are hedging only a minor part of the currency risk they are exposed to.

Bartram, Brown, and Conrad (2011)[26] using sample of non-financial firms questioned how the derivative use impact on firm risk and value by comparing samples of users and nonusers had found strong evidence that both systematic risk and total risk are much lower for firm that make higher usage of financial derivatives. Particularly during the economic downturn in 2001-2002, using derivatives is associated with significantly higher value, abnormal returns, and larger profits, suggesting firms are hedging downside risk.

Chernenko[27](2011) conclude that derivatives are used to both hedge and to speculate, particularly when executives are rewarded for successful speculation and when it empowers firms to meet particular earnings targets.

2.2. *Studies on banking industry*

We can classify studies on the subject of the importance of derivatives in the banking industry into two parts:

- In part one we list the studies relative commercial banks and the use of derivatives;
- Second part examine how use of derivatives impact of the various types of bank risks;

[26] BARTRAM, S. M.; G. W. BROWN; and J. CONRAD. "*The Effects of Derivatives on Firm Risk and Value.*" Journal of Financial and Quantitative Analysis, 46 (2011), 967–999.
[27] CHERNENKO S., Faulkender M., "*The Two Sides of Derivatives Usage: Hedging and Speculating with Interest Rate Swaps",* Journal Of Financial And Quantitative Analysis Vol. 46, No. 6, Dec. 2011, pp. 1727–1754.

One of the first studies on the topic was made by Gunther and Siems (1995)[28]. At that time the derivatives usage at in U.S. banks was very low, only few bigger banks were dominant players in the industry of derivatives, because only the largest institutions could have the necessary resources to effectively execute derivatives trading. As the consequence the authors find positive relationship between derivatives activities and capitalization. Banks analyzed at the time used derivatives more to hedging purposes than to speculation. But in general banks with the highest capital cushion can absorb bigger losses and as a result have more pronounced participation in derivatives.

Carter and Sinkey (1998) after investigating the use of interest-rate derivatives by U.S. commercial banks had evidenced that the use of interest-rate derivatives is positively related to exposure to interest-rate risk and that bank's decision to participate in interest-rate contracts is positively related to the size. Another their paper Sinkey and Carter (2000) provide similar evidence on the characteristics of banks that undertake risk management using derivatives which indicates that smaller banks are more likely to hedge.

Gunther and Siems (1996) made a study based data of U.S. bank on annual basis covering the period from 1991 to 1994 using a variant of Cragg's model to investigate empirically the decision to participate or not in derivatives activities and the extent of participation of the banks involved in derivatives market. The results reveal major differences between the determinants of banks' participation in derivatives activities and the factors influencing the extent of their participation. In particular, while not influencing significantly the decision of whether to use derivatives, capitalization is found to enhance the extent of derivatives participation. Their study also conclude that greater interest rate risk exposure is followed by increases in the bank’s use of interest-rate derivatives.

Whidbee and Wohar (1999) analyzing publicly traded bank holding companies (BHCs), find that the use of derivatives is affected primarily by the corporate governance and ownership-structure of banks and the factors major

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[28] GUNTHER J., SIEMS T., “*Who's Capitalizing on Derivatives?”,* Financial Industry Studies, July 1995.

influence are in particular managerial incentives and external monitoring. They find that high percentage of CEO shareholdings are negatively correlated with derivatives usage when insider holdings exceed 10% level.

Brewer (1996) find that there is a negative correlation between risk and derivatives usage, later (2000) find that banks that use derivatives have far more higher growth in lending, rather than banks that do not use these financial instruments, particularly in their commercial and industrial loan portfolios.

The studies Allayannis and Ofek (2001) suggests that banks with higher foreign currency exposure are more likely to engage in derivatives activities while Shyu and Reichert (2002) found evidence that international dealer banks' derivatives activities are directly related to of the bank's capital ratio, asset size, maturity gap, and credit rating, but inversely related to bank profitability.

2.3. *Effect of derivatives on different types of bank risks*

Another group of studies investigates the effect of the use of derivatives on different types of bank risks, for example interest-rate, exchange rate, market, and unsystematic.

One of the first researches Shanker (1996)[29] focuses on the use of derivatives for risk management. The effect of the use of interest rate derivatives (futures, options, and swaps) upon the interest rate risk of commercial banks is investigated. The results indicate that derivatives (swaps, future, and options) are effective in reducing the interest rate risk of banks.

In contrast, Hirtle (1997)[30] while examines the role played by derivatives in determining the interest rate sensitivity of bank holding companies' (BHCs') find that for the typical bank holding company in the sample, increases in the use

[29] SHANKER, L., 1996. "*Derivative usage and interest rate risk of large banking firms.*" The *Journal of Future Markets* 16, 459-474.
[30] HIRTLE, B., 1997. "*Derivatives, portfolio composition, and bank holding company interest rate risk exposure.*" Journal of Financial Services Research 12, 243-266.

of interest rate derivatives corresponded to greater interest rate risk exposure during the 1991-94 period. This connection is particularly robust for bank holding companies that serve as derivatives dealers and for smaller BHCs.

Choi and Elyasiani (1997)[31] estimates the interest rate and exchange rate risk betas of 59 large U.S. commercial banks and find that options are related positively to currency risk and interest-rate, overall, the exchange rate risk betas are more significant than the interest rate risk betas, while currency swaps reduce exchange rate risk.

Chaudhry and Reichert (1999) and Chaudhry et al. (2000) find that the use of options tends to increase all market-based measures of bank risk, while empirical results suggest that interest rate and currency swaps significantly reduce bank risk and used primarily for risk-control purposes. And ultimately the use of forward contracts and currency commitments contributes marginally to any type of risk.

Table 1. Derivatives usage by different Bank holding companies

Classification of Derivatives	All BHCs	Very Large BHCs	Large BHCs	Mid-sized BHCs	Small BHCs
Trading—interest rate	82.66%	83.23%	53.76%	32.14%	7.26%
Trading—foreign exchange	11.85%	11.68%	21.73%	3.22%	1.18%
Trading—equity	1.43%	1.42%	1.76%	0.32%	0.01%
Trading—commodity and other	0.42%	0.41%	1.35%	0.05%	0.01%
Trading—total	96.36%	96.73%	78.59%	35.73%	8.45%
Other-than-trading—interest rate	3.46%	3.10%	20.35%	60.86%	88.80%
Other-than-trading—foreign exchange	0.17%	0.16%	1.04%	2.39%	0.22%
Other-than-trading—equity	0.01%	0.00%	0.02%	1.02%	2.48%
Other-than-trading—commodity and other	0.00%	0.00%	0.00%	0.00%	0.06%
Other-than-trading—total	3.64%	3.27%	21.41%	64.28%	91.55%

[31] CHOI, J., ELYASIANI, E., 1997. "*Derivative exposure and the interest rate and exchange rate risks of U.S. banks*", Journal of Financial Services Research 12, 267-286

Nissim and Penmann[32] (2007) in their research paper have analysed data from essentially all regulatory consolidated financial statements submitted by BHCs[33] to the Federal Reserve System from 2001 to 2005. Thus, the sample covered essentially all of the banking industry during the five years from 2001 to 2005. All observations were divided for five samples.[34] Banks are required to classify derivatives based on the underlying activity—trading versus non-trading. Table 7 presents the distribution of derivatives by their exposure—interest rate, foreign exchange rate, equity prices, and prices of commodity etc. In line with data mentioned previously from Bank for international settlements, interest rate derivatives represent the large majority of derivatives and foreign exchange contracts come second. From the table we can clearly conclude that majority of banks very small percentage of derivatives in the trading classification. However, the largest BHCs employ derivatives almost entirely for trading purposes, more than 96% of all derivatives (based on notional amounts) were classified as trading.

Reichert and Shyu (2003) comparing international banks by using a three-factor multi-index model and a modified value-at-risk (VaR) analysis find that use of options increases the interest rate beta for all banks, while both interest rate and currency swaps generally reduce risk.

Some other studies are focused primarily on impact of credit derivatives and hedging against financial distress Duffee and Zhou (2001). Norden, Buston, and Wagner (2011) that banks use credit derivatives to improve their credit risk management.

32 NISSIM D., PENMANN S., 2007, *Fair value accounting in the banking industry*, Columbia Business School

[33] Bank Holding Company is a bank with total consolidated assets of $150 million or more, or that satisfy certain other conditions as provided by the Bank Holding Company Act of 1956.

[34] (1) firm-quarter observations with total assets less than $1 billion (small BHCs); (2) $1-10 billion (mid-sized BHCs); (3) $10-100 billion (large BHCs); (4) greater than $100 billion (very large BHCs); and ultimately (5) all BHCs.

Chapter 3. Derivatives and systematic risk

3.1. *Research Method*

The aim this study is to verify the impact of derivatives use on systematic risk where the variable of systematic risk is measured by bank's beta, in particular, whether or not exist any linear relationship, positive or negative.

In case of positive linear relationship, an increase of derivatives usage would increase the systematic risk of the bank, and vice versa, in case of negative linear relationship, a higher usage of derivatives would result in decreasing of beta, which could be explained as a result of efficient hedging policies implemented by the banks.

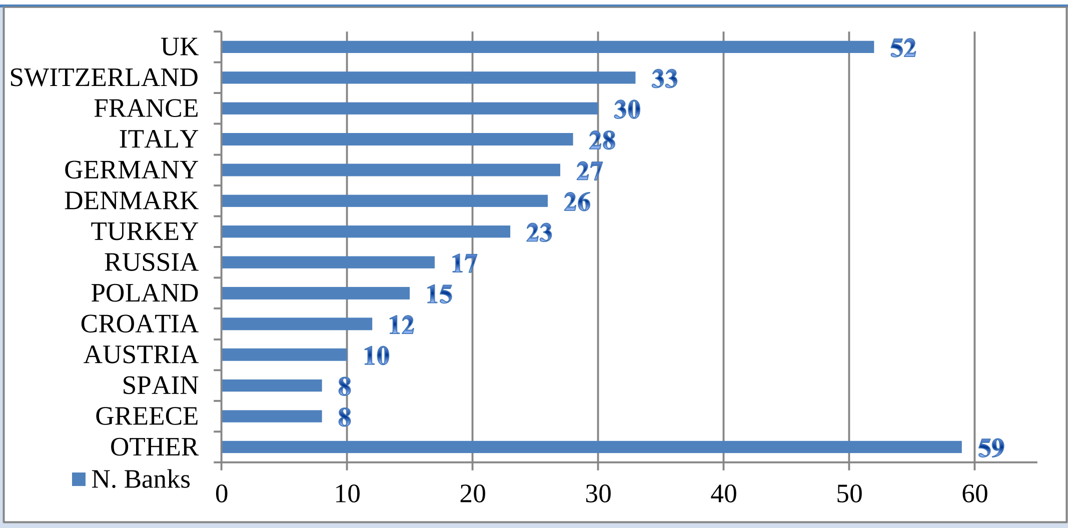
The main variable of interest is the total amount of the derivatives used by the banks, that for comparability purposes is given by the ratio of derivatives to total assets and used as independent variable together with other control variables in our regression model. We use statistical software STATA in order to determine both the sign and the extent of the relationship. For this purpose is used Multiple Linear Regression Model and estimation by ordinary least squares (OLS), by which it can be estimated the relationship between a dependent variable (beta) and e set of explanatory variables, the derivatives and control variables in our case.

However, before proceeding with the analysis, first we indicate the source of the used data and describe the basis of the model. In the following paragraphs it is indicated the size of sample used for estimation and how had been gathered the information. The control variables had been constructed through research of the most relevant literature on the determinants of systematic risk, and the variables that were cited more frequently and provided more significant impact were included in the definitive model. In the next pages the underlying motivation of usage every single variable and expected hypothesis of impact will be provided more in detail.

3.2. *Data collection and sample description*

In order to conduct the analysis properly and build the sample the financial data was obtained mainly from two databases: Bankscope and DataStream. The data relative to derivatives amounts, both Derivatives assets and liabilities, was obtained from balance sheet values of Bureau van Dijk's Bankscope database. Also from this source comes all the balance sheet data used to calculate various financial ratios that were used as control variables in the analysis. The historical

Table 2 : Sample database Number of banks by country



Source: author's own calculations from database

betas on yearly basis is added from Thomson's DataStream, while Bankscope provide an option to add missing data using the average beta to reference index calculated to 1, 3 and 5 years.

The sample of our study consist of European listed banks with highest market capitalisation of the EU-28 countries considering all available data for the past ten years till 2013 and also were included listed banks from Switzerland, Turkey and Russia. The extensive sample of different banks from various countries was taken in order to decrease differences among banks based in different countries and also to reduce the impact if different fiscal policies.

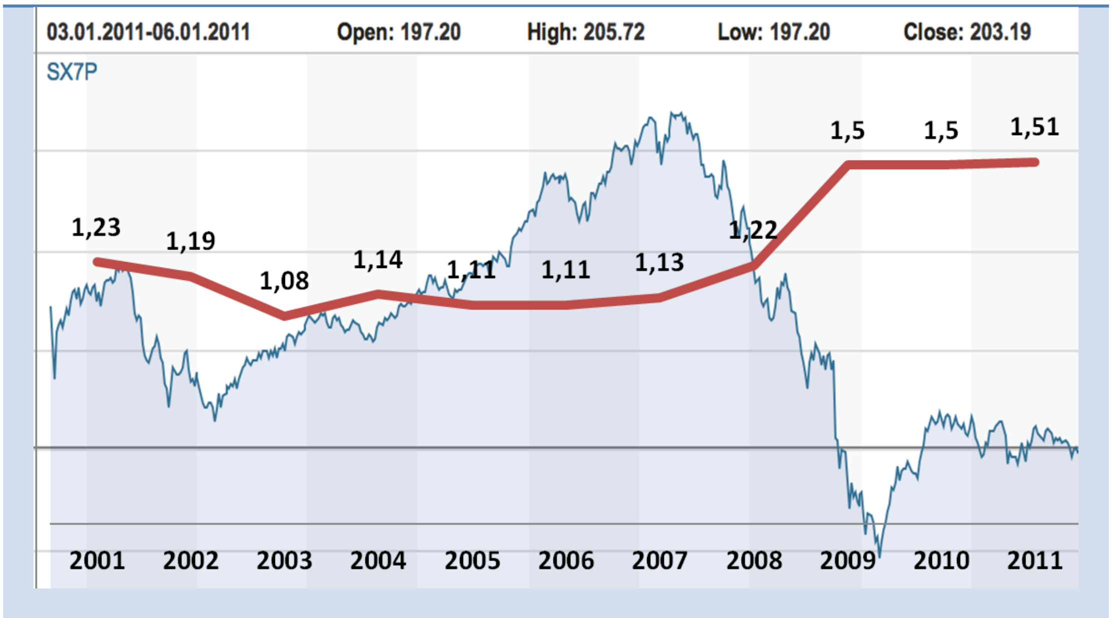
Using the first research criteria a sample of total 350 banks was obtained, still this number was further revised due to some missing data and mainly due to elimination of outliers from the sample of observations with a final sample of 261 banks.

3.3. *Dependent variable: systematic risk (beta)*

Due to its numerous practical applications it is very useful to understand the determinants of beta. In this section we state only some general definitions, as more detailed and clear explanations can be found in dedicated literature.

Beta ***(β)*** of the security can be defined as sensitivity of security's return to the return of market portfolio, or how sensitive the stock is to systematic shocks that affect whole economy. More precisely "expected % change in return of the security, given 1% change in the return of the market portfolio." For practical purposes, different stock indices as MSCI World, S&P500 and FTSE 100 are used as a proxies for a market portfolios.

Graph 10 : Avg. Beta in European and US Banks, to STOXX® Europe 600[35]



Source: PWC, "*Banking industry reform. A new equilibrium. Part* 2." Detailed report. 2012

[35] http://www.stoxx.com/indices/

Comparing Eurostoxx 600 banks index and average beta of the banks (see graph 10), higher volatility in prices correspond variation of systematic risk, as sharp decline in banks stock prices in 2008 resulted in increased undiversifiable systematic risk .

The banking industry is increasingly exposed to systematic risks on financial markets and highly involved in financial derivatives business. It is our major aim to study the degree of this involvement, not only major players, bud for the industry as a whole. If the banks are driven by speculating intentions rather than by hedging we assume that financial derivatives will increase the systematic risk of the banks. In particular larger banks often diversify their activities and move from their core business to increase gains by engaging in trading of financial derivatives, or in general use derivatives for speculative purposes. To analyze whether financial derivatives contribute in some extent to increase a systematic risk of the banks we formulate the following hypothesis:

H1: There is a linear relationship between the use of financial derivatives and systematic risk defined by beta***(β)***.

3.4. *Variable of interest – derivatives ratio*

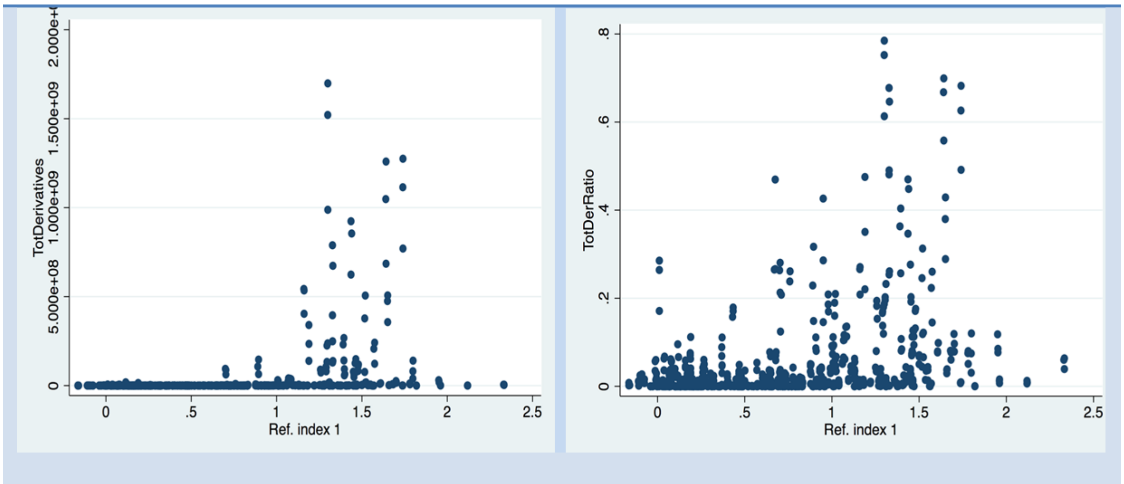
In this study to represent the amount of derivatives that are reported in the balance sheet of the banks we use approach similar to Hentschel and Kothari (2001) [36] normalizing total notional amount of derivatives by market value of total assets of the bank in order to compare the exposure to derivatives by notional amount. Market value of assets is calculated summing market value of equity and total liabilities. Such approach, used also by Sinkey and Carter (2000) was preferred to normalizing the total notional amount of derivatives by natural logarithm due to multicollinearity issues, as usually larger banks are more inclined to have more derivative in their balance sheet statements, so natural logarithm of derivatives used as a control variable, would co-vary positively with logarithm of

[36] HENTSCHEL L.,. KOTHARI S.P., "*Are Corporations Reducing or Taking Risks with Derivatives?",* Journal of Financial and Quantitative Analysis, vol. 36, no. 1 (March 2001):93–118

total assets in this case. Dividing notional amount of derivatives by total assets we report the value using the same scale. Total derivatives ratio calculated as follows:

$$\text{DERIVMV}=\frac{Total\ derivatives}{Market\ value\ of\ assets} \quad ; \quad DERIVTA = \frac{Total\ derivatives}{Total\ assets}$$

Graph 11 : Total derivatives, notional amount vs ratio on total asses



Source: STATA, two-way graph, derivatives to reference market beta

3.5. *Control variables definition*

In order to control the outcome and construct more statistically significant result Multiple linear regression is preferred to simple linear regression. In our analysis we will use several control variables, that were used by authors in previous mentioned literature and other more specific, found to be significant for measuring systematic risk. The control variables are:

- Size
- Loans to customer deposits
- Book to market ratio
- Net interest margin
- Leverage
- Dividend pay-out

The approach used to study the relationship between bank's historic beta as a proxy of systematic risk and derivatives is multivariate analysis that will be conducted using formula that is explained in detail further.

3.5.1. Leverage

To control for leverage we rely on classical theory, using financial leverage as a predictor of systematic risk. Equities with higher financial leverage usually bear higher systematic risk and investors require higher rate of return for bearing this risk. Accordingly both to Modigliani-Miller theory and CAPM, we assume that banks with higher leverage are more riskier due to higher probability of default and volatility of earnings, as a result of higher interest expenses. Consequently to this assumption a positive relationship between systematic risk of the bank and leverage is expected. A relevant set of studies of impact of derivatives on the value of non-financial firms [37] found a significant impact of leverage on systematic risk, arguing that leverage contributed to increase the systematic risk of most of the firms under the study. It was also mentioned that higher leverage was one of the factors that contributed to higher usage of derivatives.

The estimation of the leverage ratio is used by classical Total Debt to Equity ratio, calculated as book value of debt divided by book value of equity.

$$DE = \frac{Total\ Book\ Value\ of\ Debt}{Book\ Value\ of\ Equity}$$

Debt to equity ratio is considered as crucial in this study, as balance sheets in banking industry are far more leveraged than in non-financial companies.[38]Higher leverage increase also the volatility of stock returns, as in

[37] BARTRAM M., BROWN G., CONRAD J., "*The Effects of Derivatives on Firm Risk and Value*", Journal of Financial and Quantitative Analysis, Vol. 46, No.4, August 2011, pp. 967-999.
[38] YANG J., TSATSARONIS K., "*Bank stock returns, leverage and the business cycle. BIS Quarterly Review*", Bank for International Settlements, (2012)

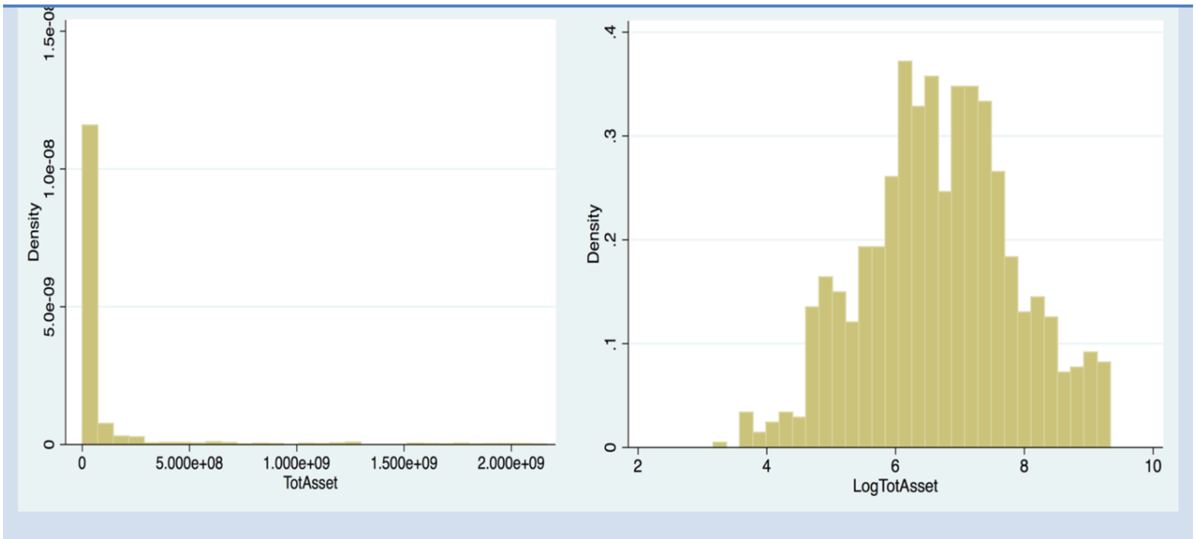
recent decades the volatility of stock prices of financial institutions like banks was far more higher compared to volatility of non-financial firms. [39]

Hypothesis 2: there is a linear relationship between bank leverage and systematic risk.

3.5.2. Total assets

The total amount of assets of the company is far the most used[40] predictor of the systematic risk and mentioned in almost every study. Therefore, the impact of size on systematic risk is quite ambiguous and different results are reported depending on the industry. In general, as size of the company increase, the overall risk, both total and systematic, decrease, mainly due to diversification effects.

Graph 12 : Distribution of sample banks, Total assets nominal vs LN scale



Source: STATA, appropriate transformations found using "gladder" command.

However, some studies report that in the banking industry the diversification effects are offset due to their higher exposure. Demsetz and

[39] RAMADAN Z., "*Does Leverage Always Mean Risk? Evidence from ASE",* International Journal of Economics and Finance; Vol. 4, No. 12; 2012

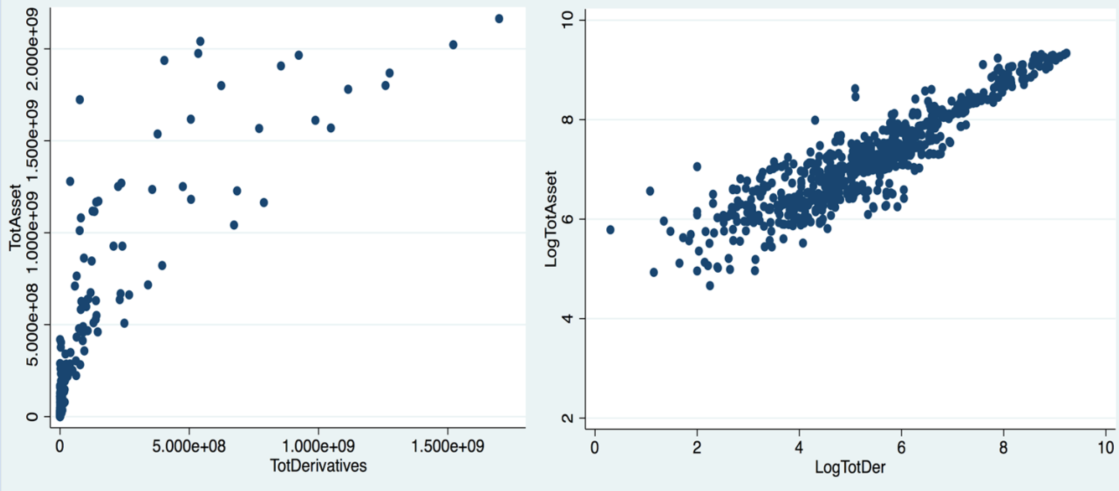
[40] MANSUR H., ZITZ M., "*The association between banks' performance ratios and market-determined measures of risk".* Applied Economics, 1993, 25:1503-1510

Strahan (1997) [41] conclude that even thou banks are far more diversified and have more competitive advantage over the smaller banks, they often operate with significantly higher leverages that offset major part of the benefits of the diversification.

The natural logarithm of banks' total assets is used as proxy for a bank size. As evidenced from the graph 11, using this approach the data is represented following approximately the normal distribution.

Some theorist find significantly positive coefficients on relationship between the firm size and derivatives usage. Evidenced on the graph 12 a clear support for this proposition. We can see as to higher notional amounts of total assets (as measure of bank size), correspond higher notional amount of derivatives. For explanatory purposes the values are also reported using logarithm scale. One of the arguments of such findings are that due to scale economies, larger banks are more incentivized to use derivatives as also evidenced by Sinkey and Carter (2000).[42]

Graph 13 : Derivatives to total assets, nominal vs logarithm scale



Source: STATA

[41] DEMSETZ R., STRAHAN P., "*Diversification, Size, and Risk at Bank Holding Companies",* Journal of Money, Credit and Banking, Vol. 29, No. 3 (Aug., 1997), pp. 300-313
[42] SINKEY F., CARTER D., "*Evidence on the financial characteristics of banks that do and do not use derivatives",* The Quarterly Review of Economics and Finance, Volume 40, Issue 4, Winter 2000, Pages 431–449

3.5.3. Dividend pay-out

Most studies of non-financial firms reveal negative correlation of high dividend pay-out on systematic risk, as due to higher dividend pay-out investors perceive more certainty in flow of returns, in such case higher dividends are perceived positively by investors as a result of profitable economic activity and financial stability of non-financial firm. Also high dividend stocks offer a certain level of protection in down markets as counterweight to stock price losses in case of negative capital gains.[43]

The studies of Jahankhani and Lynge (1980) are one of the most cited in examining the relationship between systematic risk and accounting measures of risk. In particular the accounting measures that were found most significant in measuring both total and systematic risks were: leverage, dividend pay-out, and loan to deposit ratio .

In contrast, in the banking sector higher dividend pay-out ratio may contribute to the to the overall risk, as a result of more risky strategies adopted by banks in order to increase earnings. [44] Consequently for banks, high retention rates of dividends are crucial to build sufficient capital buffers, in order to be less susceptible to all types of risk. In line with the studies of Rosenberg and Perry (1981) cited previously, we include dividend payout ratio in the regression model as one among the most significant predictors of bank's systematic risk. Dividend payout ratio is calculated as follows:

$$\text{Dividend Payout} = \frac{\text{Annual dividend Payment}}{\text{Net Income}}$$

[43] CLINEBELL J., SQUIRES J., STEVENS J., *"Investment performance of high income stocks over up and down markets."* Journal of Economics and Finance, 1993, Volume 17, Issue 2, pp 77-91

[44] ONALI E., "*Dividends and Risk in European Bank"*s, 2009; see also :Moral Hazard, Dividends, and Risk in Banks. Journal of Business Finance & Accounting, 2014, 41: 128–155.

3.5.4. Liquidity risk. Loan to customer deposits ratio.

In order to control for liquidity impact on systematic risk, in the regression model is included liquidity ratio as a control variable. Loans to deposits ratio was found also to be significantly correlated with loans to total asset ratio. Both of this ratios are generally used as a proxy of potential liquidity issues .[45] In particular, loans to deposits ratio provide an important insight about overall structure of funding sources of the bank. When equal to 1 the ratio indicates that major part of the granted credit is covered by total customers deposits, which are more stable funding source. In essence, those banks that cover most of the loans with customer deposits are less exposed to liquidity issues, as they are not forced to be dependent on wholesale funding markets in order to cover their funding gap[46]. In contrast, higher values of ratio indicate that part of the banks loans are financed with more expensive sources like wholesale market funding. In recent years, when wholesale funding markets became more accessible, banks have diversified their funding sources moving from traditional intermediation approach, where funding of the loans was made through customer deposits. Some studies observed an increase of this ratio throughout banks in different countries. [47] Even if this ratio used separately may not provide complete information, it gives however a useful insight about liquidity issues in banks, it is also used frequently in some of previously mentioned studies.

The ratio is included as a control variable and we expect negative sign of coefficient (-), meaning that higher values of ratio have negative impact on systematic risk of the bank.

$$LTCD = \frac{Total\ Loans}{Total\ Customer\ Deposits}$$

[45] SALKELD M., "*Determinants of Banks' Total Risk: Accounting Ratios and Macroeconomic Indicators*" (2011). Honors Projects. Paper 24

[46] Funding gap is usually explained as the difference between loans and customer deposits.

[47] BONFIM D., Moshe K., "*Liquidity Risk in Banking: Is There Herding?*", European Banking Center Discussion Paper No. 2012-024, 2014

3.5.5. Net interest margin

To control for intermediation profitability we use net interest margin ratio (NIM), as this is one of the most commonly used indicators of the cost efficiency in banking industry. Price/Earnings ratio could also be used as proxy for profitability, but earnings have higher volatility and fluctuations on yearly basis and gives lower representation of underlying value of bank.

However, if we consider industry as a whole, usually higher margins are associated with lower banking sector efficiency, due mainly to averse macroeconomic conditions and higher uncertainty that tend to increase interest margin. While in most of developed financial markets interest margins are on average much lower.

From the single bank perspective, smaller banks have considerably higher NIM when they work with riskier clients, consequently higher NIM are viewed as compensation for higher risk. However, larger banking institutions have lower interest expenses per unit of income due to economies of scale.

We assume positive correlation between risk and return. In this case the banks have higher returns when they take more riskier activities. Consequently higher interest margin should be positively correlated with systematic risk of the bank.

$$NIM = \frac{Net\ Intrest\ Income - Net\ Interest\ Expences}{Total\ Earning\ Assets}$$

3.5.1. Other control variables

In order to construct a robust and significant coefficients in the regression last control variable that we use in the model is price-to-book ratio, as it is often used as a predictor of firms future earning capacity. Hong and Sarkar (2007)[48] show empirically in their study that market-to-book ratio is an significant determinant of equity beta. They evidence that stock's beta is sensitive to growth

[48] HONG G., SARKAR S., "*Equity Systematic Risk (Beta) and Its Determinants*", Contemporary Accounting Research Vol. 24 No. 2 (Summer 2007) pp. 423–66

opportunities and market-to-book ratio (or more commonly used as Price-to-book) is used as a proxy, to verify the magnitude of such opportunities because they cannot be verified directly.

$$\frac{P}{B} = \frac{Market\ Capitalisation}{Book\ value\ of\ equity} = \frac{Stock\ price}{Book\ value\ per\ share}$$

Most of the reviewed studies mentioned significant relationship between the market-price to book-value ratio (P/B) with systematic risk. However the sign of the impact (positive or negative) resulted somehow contradictory. In particular more dated paper of Harris and Marston (1994)[49] evidence that market beta is positively related with book-value to market-value (BV/MV), in particular emphasizing that smaller companies on average have higher earnings and growth opportunities cause higher stock market returns. Lastly they conclude that book-value to market-value ratios are better explained by growth opportunities rather than by beta itself.

However Yang and Tsatsaronis (2012) by analyzing a large sample of banks with their empirical model, have obtained results that bank profitability was negatively correlated with systematic risk. The logic of this statement was motivated as more profitable banks are less pressed to provide higher stock returns, so the stock returns are less volatile compared to the market, with lower beta as a consequence. In ultimate analysis bank market beta is positively correlated with leverage, in line with previously mentioned literature, and the ratio book-value to market-value (BV/MV). A particular insight from this study is that the systematic risk of bank stocks is different through various phases of the business cycle: lower during economic expansion, and higher throughout recessions.[50]

In our model, however, we rely on indication of Hong and Sarkar (2007) and expect positive relationship between systematic risk and price-to-book ratio.

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[49] HARRIS R., MARSTON F.C., "*Value versus Growth Stocks: Book-to-Market, Growth, and Beta*", Financial Analysts Journal, September/October 1994, Volume 50 Issue 5

[50] TSATSARONIS K., YANG J., "*Bank Stock Returns, Leverage and the Business Cycle.*" BIS Quarterly Review, March 2012. Available at SSRN: http://ssrn.com/abstract=2100407

3.6. *Regression model*

In order to examine the extent to which banks, either through their use of derivative with different underlying assets for trading or hedging purpose, can mitigate a market wide decline. We follow approach similar to Hentschel and Kothari (2001). The multivariate regression model that estimates banks beta, as function of both on-balance sheet derivatives and traditional on-balance sheet banking activities as follows:

$$\beta_x = \alpha_0 + \alpha_1 DERIVMV_i + \alpha_2 DE_i + \alpha_3 LNMVASSET_i + \alpha_4 LLRGR_i + \alpha_5 DIVP_i + \alpha_6 NIM_i + \alpha_7 LTCD_i + \alpha_8 PB_i + \varepsilon_i$$

DERIVMV	total derivatives ratio, calculated as notional amount of derivatives divided by market value of assets;
DE	debt-to-equity ratio;
LNMVASSET	the natural logarithm of a bank's market value of total assets to control for the effect of size;
LLRGR	Loan loss reserves to gross loans
DIVP	Dividend payout ratio
LTCD	Loans to total customer deposits;
NIM	Net interest margin;
PB	Price-to-book ratio;

Chapter 4. Empirical research

4.1. Reference index beta calculation

As Thomson Reuters DataStream provide only current (last available) and not historical Beta as datatype. In order to obtain market β(beta) as a measure of risk of the stock to general market movements it is necessary to use "expression picker (fx)" option and use expression 851E. The beta of a stock is the slope coefficient in the following equation:

$$\mathrm{r}_{yt} = \alpha + \beta\,\mathrm{r}_{xt}$$

Where r_{yt} represents the return of the equity in the given month and r_{xt} is the return of the market portfolio over one month. As a proxy of the market portfolio we use the return of the reference index in this case. Through the expression 851E DataStream calculates Beta as a function of following parameters:

$$REGB\#(LN\#(X/LAG\#(X,1M)),LN\#(Y/LAG\#(Y,1M)),60M).$$

From the formula more in detail, the LAG# function takes observations relative to the following period (1 month in this case), r_{xt} - the returns of the market index X are represented as below:

$$\mathrm{r}_{xt} = \ln\#\left(\frac{X}{LAG\#(X,1M)}\right)$$

Consequently, r_{yt} - the returns of the stock Y are denoted as:

$$\mathrm{r}_{yt} = \ln\#\left(\frac{Y}{LAG\#(Y,1M)}\right)$$

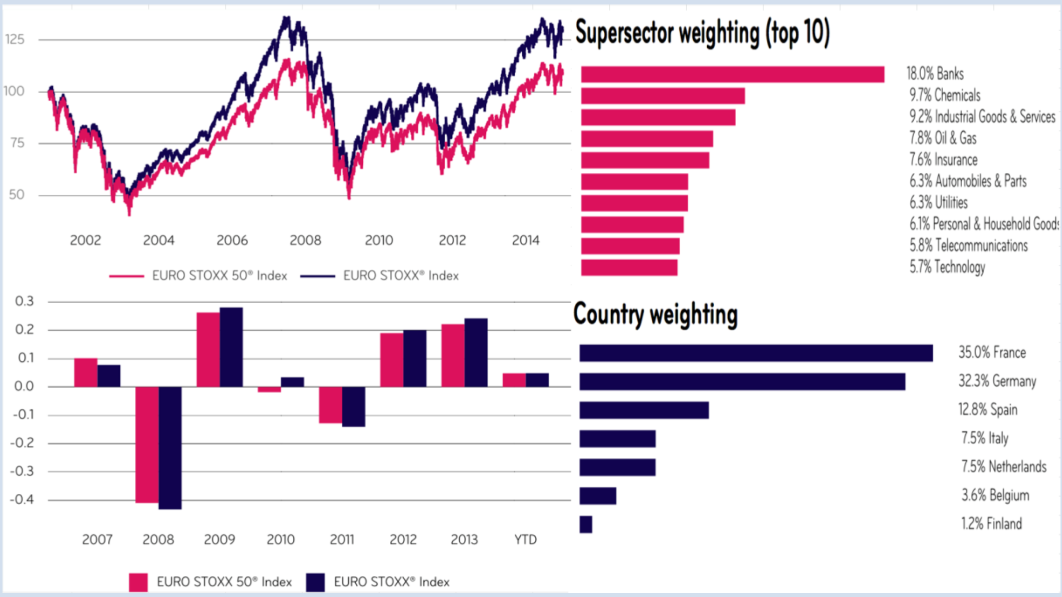
The estimation period taken for consideration was 5 years (60M - months) and the historical beta value of the given stock is obtained as estimation of slope coefficient of the regression line.

4.1.1. Reference index description

In order to obtain best matching data for beta calculation for sample of banks in this study we use multiple reference indexes, in particular STOXX Europe 600 index and STOXX Europe 50.

STOXX Europe 50 (DJES50I) is the index that aims to provide the representation of performance of the largest companies in Eurozone or supersector leaders of their region[51] in terms of free-float market capitalization. The subset of companies is selected from the STOXX Europe 600 Index and covers almost 60% of free-loan market capitalisation in Europe. It is considered one of the best

Graph 14 : Euro STOXX 50 Index, weighting by sector and country



Source: http://www.stoxx.com/download/indices/rulebooks/stoxx_indexguide.pdf

benchmarking indexes for Eurozone and used frequently as underlying for different financial products due to its high liquidity.

[51] Countries that are included in the STOXX Europe 50 index are 12: Austria, Belgium, Finland, France, Germany, Greece, Ireland, Italy, Luxembourg, Netherlands, Portugal and Spain.

However, for the purpose of the study STOXX Europe 600 Index (DJSTOXX)[52] is more representative, as it covers broadest set of companies from more European countries, including small, middle and large capitalisation stocks all over the region.[53] This index is used as it represents expansive type of industries in order to capture the performance not only of the banking sector (like for example Europe 600 Banks Index), but the performance of the market as a whole. The results of the findings are presented in the summary table including both mentioned indexes.

4.2. *The empirical model and hypothesis formulation*

In this paragraph, we use a Multiple Linear Regression Model explained in chapter 3 to verify, whether the derivatives usage by the banks is actually significant and how it relates to banks systematic risk. Using dependent and explanatory (control) variables, the regression equation will identify the best fitting line based on the Ordinary Method of the Least Squares (OLS).

$$\beta_X = \alpha_0 + \alpha_1 DERIMV_i + \Sigma\, \gamma j\ CONTROL\mathrm{ijt} + \varepsilon i$$

Using this model, where *CONTROL* stands for the γ_j control variables of firm *i* in year *t*, we will verify if there is enough evidence in order to reject the null hypothesis, which is formulated as follows:

- H_0) In the sample, there is no linear relationship between the usage of derivatives and systematic risk;
- H_1) In the sample, there is a linear relationship between derivatives usage and systematic risk:

Simple Linear Regression involve only one independent variable, The basic assumptions of multiple regression analysis are the same as in. However, using

[52] DataStream's formulation (DJSTOXX) is used, as STOXX all indices were renamed in 2009 and "DJ" prefix was removed after Dow Jones exited the joint venture with Deutsche Börse and SIX Group.

[53] STOXX Europe 600 represent a total of 18 countries, to previously mentioned are added Czech Republic, Denmark, Sweden, Norway, Switzerland and the United Kingdom.

higher number of independent variables, in multiple regressions to make the model more reliable and to avoid inaccurate results it is necessary to verify the collinearity of the variables, or if there is perfect linear relationship among the predictor variables. The following part in first place describe the variables and after the variables are checked for collinearity.

4.2.1. Variables descriptive statistics

First, we summarise the variables in order to investigate the effect of derivatives on the systematic risk than we run the multiple regression using variables according to the model explained in Chapter 3. The outcomes have been provided from the statistical software STATA. To run the analysis we relied, on average, on

Table 3 : Summary and descriptive statistics of the variables for 2000-2013

Variable	Obs	Mean	Std. Dev.	Min	Max
DJSTOXX60M	2969	.964108	.775009	-1.934	4.25576
LNMVAssets	2763	15.34925	2.791405	4.60517	21.64585
DERIVMV	2763	.0400719	.1016657	0	1.106277
PriceBook	2045	1.325335	1.601638	.006	26.738
NIM	4437	.0204933	.0506722	-.36849	1.06674
LLRGL	4437	.0232962	.0408965	0	.57514
LTCD	4437	.6942639	.9491509	0	9.9746
DebtEquity	2708	11.47876	8.963309	.1086321	114.1553
DIVP	1106	.5643038	.6196584	.08	5.73359

Source: STATA, ***summarize***

1956 firm-year observations from 2000 to 2013. The dataset is summarised in table 3. Low mean of DERIVMV variable shows in line with previously mentioned theory, that most of the banks are have low exposure to derivatives contracts compared to total assets. In contrast, most of the contracts are present in the balance sheets of bigger banks due to scale economies, this relationship will be verified further in the research. Due to the limited number of observations, the Dividend payout variable gave only marginal explanation of the dependent variable Beta and the coefficient had low significance with high p-values and low t-statistic. As a consequence earning per share ratio (EPS) was included, found to be statistically significant and increased explanatory power of the model. The results can be compared in the summary table.

4.3. *Multicollinearity issues*

One of the shortfalls of the multiple regression analysis is collinearity among the variables, which occurs when two or more predictor variables are highly correlated, meaning that one can be linearly predicted from the others. The term multicollinearity is used in case when more than one variable are involved. With increasing multicollinearity we can observe higher standard errors and the estimates of the coefficients of the regression model become less stable. To

Table 4 : Pairwise correlations of the variables

	DJST~60M	DERIVMV	LogMVA~s	PriceB~k	NIM	LLRGL	LTCD	DebtEq~y	DIVP
DJSTOXX60M	1.0000								
DERIVMV	0.2211*	1.0000							
LogMVAssets	0.3678*	0.4703*	1.0000						
PriceBook	-0.0046	-0.0805*	-0.1459*	1.0000					
NIM	0.0548*	-0.1155*	-0.1515*	0.0549	1.0000				
LLRGL	0.0786*	-0.0900*	-0.0542*	-0.1003*	0.1818*	1.0000			
LTCD	0.0396	0.0377	0.2322*	-0.2011*	0.1526*	0.3062*	1.0000		
DebtEquity	0.1432*	0.4081*	0.5319*	0.0069	-0.1556*	-0.0185	0.0999*	1.0000	
DIVP	-0.0053	0.0671	-0.0776*	0.0062	-0.0381	-0.0174	-0.1596*	0.0088	1.0000

Source: STATA, ***pwcorr*** **,** numbers pointed with the stars indicate significance at 1% level;

control for multicollinearity in this case, it is necessary check the correlation among the variables. From table 4 it is clear that most of the predictor variables are not correlated, while we find some significant correlation between debt to equity ratio and the size (logarithm of market value of assets), which can be explained by fact that larger banks have more leveraged balance sheets.

To further control for multicollinearity we check for the variance inflation factors (VIF) with help of STATA. VIF measures the increased variance of an estimated regression coefficient comparing to the case if the variable were completely uncorrelated. Higher VIF indicates multicollinearity issues and is critical if it exceeds the value of 10.

$$VIF = \frac{1}{1 - R^2}$$

Where R^2 represents the regression of all independent variables to the variable under exam. In contrast higher tolerance level $(1 - R^2)$ indicates lower collinearity. Table 5 present the measures of the strength of the relationships among the variables. In case of completely uncorrelated independent variables both VIF and tolerance would be equal to 1.

Table 5 : Variance inflation factors (VIF)

Variable	VIF	SQRT VIF	Tolerance	R-Squared
DERIVMV	**1.46**	**1.21**	**0.6845**	**0.3155**
LNTotAssets	**1.73**	**1.32**	**0.5770**	**0.4230**
PriceBook	**1.15**	**1.07**	**0.8696**	**0.1304**
NIM	**1.08**	**1.04**	**0.9285**	**0.0715**
LLRGL	**1.05**	**1.03**	**0.9497**	**0.0503**
LTCD	**1.11**	**1.06**	**0.8970**	**0.1030**
DebtEquity	**1.51**	**1.23**	**0.6629**	**0.3371**
EPS	**1.01**	**1.01**	**0.9863**	**0.0137**
Mean VIF	**1.26**			

Source: STATA, ***collin*** **,** additional module can be downloaded using *find collin* command

After more detailed examination of the variables for collinearity issues, we can conclude that overall correlation among independent variables is low. Fortunately, in our case all variance inflation factors are close to 1 with high tolerance level so there shouldn't be significant impacts of collinearity on the regression results.

4.4. *Regression results*

The first regression take the systematic risk(**β**) of banks in the sample compared to STOXX Europe 600 index as a dependent variable. The outcomes of the regression are presented directly with STATA layout (Table 4). In this chapter we focus on interpretation of obtained results and comment the regression coefficients and their significance in order to verify whether or not we can reject the Null hypothesis.

Trough total number of 1953 observations we had obtained a significant R-squared of 19,41%. This number explains what percentage of the variance of the response variable Beta is explained by our regression model. The adjusted R-squared 19,04% is usually lower as it takes into account the number of predictor variables in the model. The accuracy of the model can be

Table 6 : Regression

Source	SS	df	MS
Model	215.750872	8	26.968859
Residual	895.781718	1944	.460793065
Total	1111.53259	1952	.569432679

Number of obs	= 1953
F(8, 1944)	= 58.53
Prob > F	= 0.0000
R-squared	= 0.1941
Adj R-squared	= 0.1908
Root MSE	= .67882

DJSTOXX60M	Coef.	Std. Err.	t	P>|t|	[95% Conf.	Interval]
DERIVMV	.6168269	.1682605	3.67	0.000	.2868368	.9468169
LNTotAssets	.1291933	.0078284	16.50	0.000	.1138403	.1445462
PriceBook	.0480373	.0123215	3.90	0.000	.0238725	.072202
NIM	1.08357	.2499001	4.34	0.000	.5934695	1.57367
LLRGL	2.380032	.3741241	6.36	0.000	1.646305	3.113758
LTCD	-.0509494	.0160856	-3.17	0.002	-.0824963	-.0194025
DebtEquity	-.0095196	.0020517	-4.64	0.000	-.0135433	-.0054959
EPS	-.0002522	.0000669	-3.77	0.000	-.0003834	-.0001211
_cons	-1.067673	.1201472	-8.89	0.000	-1.303304	-.8320424

Source: STATA, ***regress***

also be partially explained by the root of mean-square-errors, where lower values represent higher accuracy and in our case this value is relatively low.

In multiple regression models F-statistic test is used to verify the hypothesis under which all coefficients of independent variables considered jointly are equal to zero, so insignificant to explain the model. In our case F-statistic is 58,53 much higher than critical value of 1.9431 for F(8, 1944) with 0.05 significance level. We adopt this measure as another suggestion for reliability of the model.

Considering the coefficient of our variable of interest DERIVMV (derivatives to total market value of assets) we find it to be positively correlated and statistically significant at 95% confidence interval. We can reject the null hypothesis as p-value is lower than 0,05 and equal to 0,000. Also high t-statistic of 3.67 confirms the significance of the coefficient given by low standard error. Considering a large sample of European banks our findings are in line with previous literature, in fact banks that have more derivatives contracts in their balance sheets have higher systematic risk. As one of possible explanations might be that derivatives are used by banks to speculate or that derivatives trading activities expose those banks to higher systematic risks, which are not hedged effectively. This statement is consistent with the findings on non-financial firms that use derivatives mainly for hedging purposes. While especially larger banks being market-makers have lower costs to use derivatives for speculative purposes which increase their systematic risk.

Other control variables of the model were found also statistically significant and the major explanatory power of variation of Beta was given by the bank size (LNTotAssets). The size coefficient is positively correlated with systematic risk and with the highest t-statistic (16,50). This explained that even with higher diversification opportunities the higher values of total assets of the banks cause higher market risk exposure. Larger banks are more exposed to common shocks in the economy and are more interconnected as shown also by recent financial crisis. The findings remain consistent even changing reference index Beta to STOXX Europe 50 (DJES50I) and can be compared in the summary table.

Both net interest margin (NIM) and loan-loss reserves to gross loans (LLRGR) are positively correlated to systematic risk. As expected higher NIM is associated with riskier activities of the bank which ultimately translates to higher systematic risk. While higher loan loss reserves are positively correlated with systematic risk mainly for reasons that often provisioning of the banks is backward-looking, which means that loss reserves are mainly associated with bad loans. In line with other findings in the literature[54] we find positive and significant coefficient that higher loan loss reserves compared to gross loans are translated in higher perceived systematic risk by investors as provisions are associated with problematic loans.

Dividend payout ratio (DIVP) resulted as predicted with positive sign in line with theoretic explanation that more aggressive dividend payout policies are correlated with higher systematic risk, however due to limited data the coefficient gave insignificant results, compared to both reference indexes. In contrast earnings per share (EPS) ratio is negatively correlated and statistically significant as we can see on the summary table (results relative to STOXX 600 and Beta local Index). Higher earnings are result of higher profitability of the bank and from the obtained data we can observe more profitable banks are associated with lower systematic risk.

Liquidity issues measured by loans-to-customer deposits (LTCD) have not confirmed expectations giving the significant coefficient but with negative sign (t -3,17, p-value 0,000). However when substituted with other more used liquid-to-total assets ratio (LIQUIDTotAssets) the results confirmed negative correlation of liquidity to systematic risk, in line with the logic that liquidity is considered as shield to unpredictable shocks and institutions with more liquidity in balance sheets are considered less riskier.

Finally, contrary to what was predicted in the previous estimations the Debt to equity ratio resulted negatively correlated to the bank market risk, which is opposite to classical corporate finance theories. However, in case of European banks financial leverage may be controversial as determinant of systematic risk as capital structure of the banks can be affected by numerous factors. The first reason that is worth considering is that banking sector is much more leveraged compared to other industries. In fact the primary source of revenues are gains on spread

[54] POLATO M., PICHLER F., FLOREANI J., PALTRINIERI A., "*Credit quality, bank provisioning and systematic risk in banking business", 2012*

Table 7 : Summary table of regressions using pooled OLS[55]

Dependent variable	Beta (β) DJSTOXX	"-"	"-"	"-"	Beta (β) DJSTOXX	Beta (β) DJES50I	Beta (β) LocIndex[56]
Intercept	-.5909 (-5.90)	-.6868 (-6.13)	-.8867 (-7.84)	-1.0676 (-8.89)	-1.385 (-8.63)	-1.197 (-9.27)	-.9523 (-10.28)
DERIVMV	.3710 (2.29)	.4447 (2.70)	.5300 (3.26)	.6168 (3.67)	.5643 (2.99)	.4641 (2.83)	.5572 (4.13)
LNTotAssets	.0988 (15.16)	.1023 (14.68)	.1068 (15.49)	.1291 (16.50)	.1486 (14.78)	.1315 (15.50)	.1220 (19.42)
PriceBook		.0424 (3.53)	.0499 (4.18)	.0480 (3.90)	.0751 (5.12)		-.0004 (-3.58)
NIM			1.219 (4.89)	1.0835 (4.34)	.8643 (3.72)	.7648 (3.78)	.9817 (4.91)
LLRGL				2.380 (6.36)	1.770 (3.03)	1.664 (3.29)	.6293 (2.12)
LTCD				-.0509 (-3.17)	-.0875 (-4.23)	-.0885 (-5.02)	-.1051 (-8.32)
DebtEquity				-.00951 (-4.64)	-.0165 (-6.18)	-.0136 (-6.06)	-.0053 (-3.30)
EPS				-.00025 (-3.77)			-.0002 (-4.29)
DIVP					.0210 (0.70)	.0317 (1.21)	
Observations	2322	1994	1994	1953	1072	1075	1950
R^2	0.1346	0.1503	0.1768	0.1941	0.2418	0.2600	0.2647
F-test	180.42	117.36	85.39	58.53	42.38	53.56	87.34

between lending and borrowing interest rates. Consequently for such leveraged entities is more important the structure of debt rather than quantity, as bank debts can be covered by government guarantees, especially larger banks. Another reason is that the capital structure of the banks is under regulation of Basel Committee. Considering this factors the cost of debt for the banks is substantially reduced and subsequently its impact on systematic risk must be lower than for the other companies, so bankers are highly incentivise to choose debt funding over the equity funding.

[55] Table 7 reports the estimates of regression coefficients and corresponding T-statistic values are reported in parenthesis.
[56] Beta (β) LocIndex- is calculated in reference to local index of the bank's home country

4.5. *Fixed and random effects models*

In order to study more in detail the estimation and sign of the coefficients, we should consider other regression methodologies. The simple OLS estimation method does not take advantage of the panel structure of the data, but each observation is considered as independent. However given that our database was constructed from observations of 261 different banks with data obtained on yearly basis over time since 2000, so with the help of STATA we can use one-way fixed or random effects transformation as it include the impact of factors that are specific to each bank.

In particular controlling for fixed effects allows us to run the regression dividing the observations into 261 groups and control for impact and significance between and within groups. As described in Table 6, each bank represent our panel variable (Bank_N), while each yearly observation constitute the time variable (Year_n).

Table 8 : Panel and time variable description

```
. xtset  Bank_N Year_n
       panel variable:  Bank_N (unbalanced)
        time variable:  Year_n, 1997 to 2013
                delta:  1 unit

. xtdescribe

  Bank_N:  1, 2, ..., 261                                      n =        261
  Year_n:  1997, 1998, ..., 2013                               T =         17
           Delta(Year_n) = 1 unit
           Span(Year_n)  = 17 periods
           (Bank_N*Year_n uniquely identifies each observation)
```

In determining the difference between fixed (FE) and random effects (RE) model we use the definition from the paper of Di Biase and E. D'Apolito (2012).[57] Starting from the OLS regression used previously:

[57] Di BIASE P., D'APOLITO E., *"The Determinants of Systematic Risk in the Italian Banking System:A Cross-Sectional Time Series Analysis*", International Journal of Economics and Finance; Vol. 4, No. 11; 2012

$$\beta_X = \alpha_0 + \alpha_1 DERIMV_i + \Sigma\, \gamma j\ CONTROL ijt + \varepsilon i$$

The error term (εi) is decomposed to variable of bank specific error (λ_i) that does not change over time and an idiosyncratic error (μ_{it}) which is specific to each observation and varies over time. In FE model each group variable is considered heterogeneous and this difference is seized by the intercept term (α_i) with every bank having its own intercept, while bank-specific effects (λ_i) are considered as correlated with other observed regressors so we obtain the following equation :

$$\beta_X = (\alpha_i + \lambda_i) + \alpha_1 DERIMV_i + \Sigma\, \gamma j\ CONTROL_{\text{ijt}} + \mu_{\text{it}}$$

In case of random effects model (RE) the bank-specific effects (λ_i) are distributed independently and considered as random variables, which can be summed to the error term.

$$\beta_X = \alpha_0 + \alpha_1 DERIMV_i + \Sigma\, \gamma j\ CONTROL_{\text{ijt}} + (\mu_{\text{it}} + \lambda_i)$$

In the following section we determine if we obtain any improvements using fixed effects and random effects model over OLS. In the table 9 is reported Stata output for fixed effect model, with total 1950 observations and 251 number of groups. Each group represent different bank with average 7,8 year observations (average number is lower due to some missing data in various years) and maximum number of 13 year observations (from 2000 to 2013).

The F-test in the bottom of the layout give the evidence to accept the alternative hypothesis. In particular, the Null hypothesis states that all coefficients related to bank specific effects are equal to zero. In this test However the Null hypothesis is rejected as F-test is higher than critical value and equal 11,83. Consequently we can conclude that using fixed effects model we obtain some improvements over OLS.

We can observe that the variable DERIVMV together with proxy for size remain significant trough different models with even higher T-statistic for the variable of interest. Such results are in line with theoretical explanation that derivatives usage depends on particular bank specific characteristics. However some other control variables became insignificant, in particular LTCD and EPS.

Table 9 : Fixed effects regression, BetaLocal to independent variables

Fixed-effects (within) regression		Number of obs =	1950
Group variable: **Bank_N**		Number of groups =	251
R-sq:	within = **0.0669**	Obs per group: min =	1
	between = **0.2097**	avg =	7.8
	overall = **0.1979**	max =	13
		F(8,1691) =	15.16
corr(u_i, Xb)	= **0.1359**	Prob > F =	0.0000

Betalocal60M	Coef.	Std. Err.	t	P>|t|	[95% Conf.	Interval]
DERIVMV	.895167	.1851516	4.83	0.000	.5320166	1.258317
LNMVAssets	.0706274	.0266883	2.65	0.008	.0182818	.122973
PriceBook	-.000467	.0000877	-5.33	0.000	-.0006389	-.000295
NIM	.7153896	.4714277	1.52	0.129	-.2092535	1.640033
LLRGL	1.458157	.2980256	4.89	0.000	.8736193	2.042695
LTCD	-.0041478	.0170694	-0.24	0.808	-.0376272	.0293315
DebtEquity	-.0106058	.00179	-5.92	0.000	-.0141167	-.0070949
EPS	.0000541	.0000877	0.62	0.537	-.0001179	.0002262
_cons	-.2362742	.4243437	-0.56	0.578	-1.068568	.5960199
sigma_u	.52023463					
sigma_e	.35165028					
rho	.68638779	(fraction of variance due to u_i)				

F test that all u_i=0: F(250, 1691) = 11.83 Prob > F = 0.0000

The second step is to verify if any improvements can be obtained using the random effects model compared to pooled OLS, and ultimately execute Hausman specification test to verify which model (FE or RE) is more significant and best applies to our sample. In order to choose the appropriate estimator we compare pooled OLS and random effects model using Breusch and Pagan Lagrangian multiplier test for random effects. The results of RE estimator are presented in summary table. Based on the least squared residuals in this test if Chi-squared is high enough and consequently associated p-value is low, the Null hypothesis can

Table 10 : Breusch and Pagan Lagrangian multiplier test for random effects

Betalocal60M[Bank_N,t] = Xb + u[Bank_N] + e[Bank_N,t]

Estimated results:

	Var	sd = sqrt(Var)
Betal~60M	.4010715	.6333021
e	.1236579	.3516503
u	.2298143	.4793896

Test: Var(u) = 0

chibar2(01) = 1926.27

Prob > chibar2 = 0.0000

be rejected in favour of random effects model. From the test represented on table 10 the variance of OLS residuals is not equal to zero due to individual-specific effects, so we can choose the random effects model over pooled OLS.

Ultimately, in order to select more efficient estimator between fixed effects and random effects model we perform Hausman test with compares the

Table 11 : Hausman test

	Coefficients (b) fixed	Coefficients (B) random	(b-B) Difference	sqrt(diag(V_b-V_B)) S.E.
LNMVAssets	.0830075	.1056451	-.0226376	.0241809
DERIVMV	.6960584	.7172434	-.021185	.0885123
DE	-.0099038	-.0093081	-.0005958	.0006198
LoansCusto~s	.0063021	-.0143844	.0206865	.0085998
NetInteres~n	.8179447	.993766	-.1758213	.3538098
Pricebookv~o	-.0757266	-.053524	-.0222026	.0048529
EPS	.0000686	-.0000541	.0001227	.0000481

b = consistent under Ho and Ha; obtained from xtreg

B = inconsistent under Ha, efficient under Ho; obtained from xtreg

Test: Ho: difference in coefficients not systematic

chi2(7) = (b-B)'[(V_b-V_B)^(-1)](b-B)

= 33.98

Prob>chi2 = 0.0000

difference in coefficients in the two models. The null hypothesis in this test states that RE model is more efficient as an estimator. However we obtain significantly low p-value 0,0000 so the null hypothesis that difference across the estimator is not systematic can be rejected in favour of alternative hypothesis. Consequently after all executed tests we can conclude that the fixed effects estimator (FE) is preferred both to random (RE) and pooled OLS.

4.6. *Discussion of the results*

The aim of this chapter was to investigate whether the derivatives usage by the banks is significant and how it affects the banks systematic risk. For this purpose we used a Multiple Linear Regression Model with DERIMV as variable of interest and a set of control (explanatory) variables.

We find statistically significant results in line with previous literature that as expected, the higher derivatives usage corresponds to higher systematic risk. In first case using ordinary Method of the Least Squares (OLS) we find evidence in order to reject the null hypothesis. In fact the coefficient of DERIMV is statistically significant using even different reference indexes for Beta calculation. The highest explanatory power ($R^2 = 26{,}46\%$) was obtained using as dependent variable the market Beta in reference to local index of home country of the bank, however the models with other dependent variables provide also significant statistical results in particular the benchmark index for European market DJSTOXX 600.

Ultimately in order to consider and take advantage of the panel structure of the data we performed tests in order to verify the possible improvements over pooled OLS. Both tests for fixed and random effects resulted positive and lastly Hausman test confirmed higher efficiency for fixed effects estimator. As presented in the summary table below, the variable of interest DERIVMV obtained positively correlated coefficient (0,89) with even higher statistical significance (T-stat 4.83) considering fixed effects model. The FE model still presented slightly lower explanatory power of ($R^2 = 19{,}79\%$) as some coefficients of the control variables like EPS and LTCD became less significant considering bank-specific effects. However, such accounting predictors of systematic risk as size, loan loss ratio and debt to equity ratio remained significant across different estimation models and reference indexes.

Table 12 : Summary of regression results. Pooled OLS versus FE and RE

	POLS	FE	RE	OLS	FE	RE
Dependent variable	Beta (β) LocIndex	"-"	"-"	Beta (β) DJSTOXX	"-"	"-"
Intercept	-.9523 (-10.28)	-.2362 (-0.56)	-.7892 (-4.14)	-1.0245 (-8.92)	-2.062 (-3.81)	-1.044 (-4.44)
DERIVMV	.5572 (4.13)	.8951 (4.83)	.8365 (5.01)	.5598 (3.34)	.9157 (3.87)	.8170 (3.86)
LNMVAssets	.1220 (19.42)	.0706 (2.65)	.1064 (8.78)	.1308 (16.79)	.1895 (5.57)	.1279 (8.54)
PriceBook	-.0004 (-3.58)	-.00046 (-5.33)	-.00045 (-5.31)	.00069 (4.41)	.00084 (7.51)	.00079 (7.23)
NIM	.9817 (4.91)	.7153 (1.52)	.9311 (2.82)	1.086 (4.38)	.4993 (0.83)	.93401 (2.26)
LLRGL	.6293 (2.12)	1.458 (4.89)	1.318 (4.69)	2.293 (6.21)	2.174 (5.71)	2.184 (6.11)
LTCD	-.1051 (-8.32)	-.0041 (-0.24)	-.0162 (-1.09)	-.0592 (-3.78)	.0633 (2.91)	.05141 (2.74)
DebtEquity	-.0053 (-3.30)	-.0010 (-5.92)	-.0100 (-5.97)	-.0094 (-4.64)	-.0135 (-5.94)	-.0128 (-6.00)
EPS	-.0002 (-4.29)	.000053 (0.62)	-.000041 (-0.55)	-.00026 (-3.95)	.-00006 (-0.54)	-.00006 (-0.64)
Observations	1950	1950	1950	1953	1953	1953
R^2 within	-	0.0669	0.0646	-	0.0784	0.0755
R^2 between	-	0.2097	0.2486	-	0.0784	0.2006
R^2 overall	0.2647	0.1979	0.2339	0.2022	0.1698	0.1782
F-test	87.34	11.83	-	61.60	10.76	-

Chapter 5. The determinants of derivatives use

After verifying a relationship between derivatives usage and systematic risk, in this chapter we will analyse more in detail, which are the main motivations of the banks to participate in derivatives market. In particular, which are the specific accounting characteristics of the banking institutions that are more involved in derivatives activity.

While the main motivations of the use of derivatives by non-financial companies has been the subject of numerous researches which evidenced that non-financial firms primarily use these instruments for managing financial risks (Bartram, Brown et al. 2011). In comparison there is little number of studies that evidence motivations for banks and other financial institutions to use derivatives. The difficulty to separate in banks the use of derivatives for hedging from speculating purposes is one of the reasons. The main motive is that banks can enter in derivatives market as final users, dealers or both in the same time.

Banks as intermediaries the have very leveraged balance sheets and need effective solutions in order to manage huge exposures to interest rates and exchange rates. Allayannis and Ofek (2001) underlined that companies with a larger amount of international activities are more inclined to manage their currency exposure with derivatives. Sinkey and Carter (2000) had investigated in their paper the differences and particular characteristics of banks that used derivatives contrary to banks that did not. The main differences between users and nonusers were inferior net interest margins, higher maturity gap between short term loans and debts and lower equity capital ratios with higher risk due to more leveraged capital structures.

Other studies evidence that while smaller and medium size banks use derivatives for hedging against changes in foreign currency exchange rates and interest rates risks exposures, the larger banks are also more inclined to speculate on movements of these financial instruments. However, to a certain level almost all the banks participate as final users in the derivatives market, while only the major players act as a dealers and can provide OTC derivatives both to other banks and non-financial companies.

Relying on the previous studies we examine financial characteristics of banks in our sample relatively to extent of derivatives usage.

5.1. *Analysis description*

Derivatives provide an efficient for risk management tool and to analyse which are the characteristics of the banks that are more involved in derivatives activities we will use the created database and analogous regression methodology as in previous chapter.

The involvement of the bank and the extent of its activity is defined by notional amount of derivatives divided by the book value of total assets (DERIVTA). Whereas the main characteristics are analysed through different proxy variables of size, leverage, diversification, market risk and liquidity.

5.1.1. Size

The reason to include size as independent variable is to verify the existence of scale and scope economies in derivatives markets. As evidenced by studies of Sinkey and Carter (2000) the participation in derivative markets is obstructed by entry barriers. The major obstacle is a large amount of initial investment in intellectual capital. Adkins *et al* (2007)[58] also remark that such organizational factors training of personnel and experience of dealing derivatives products is crucial so larger banks are also more likely to participate in derivative markets. End usage is accessible to the banks independently of the size, however successful trading requires substantial investments, so some banks are indisposed to participate in role of dealers, as it requires significant amount of resources to monitor and understand derivatives activities. Larger banks are typically more

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[58] ADKINS, L. C., CARTER, D. A. SIMPSON, W. G. (2007)," *Managerial Incentives And The Use Of Foreign-Exchange Derivatives By Banks.*" Journal of Financial Research, 30: 399–413.

capable to exploit innovative instruments and develop skilled expertise due to higher technical efficiencies. Only few major institutions can take advantage of informational economies and maintain an expert trading function, which explains why derivatives industry is dominated by few larger banks.

As a proxy for the size we use natural logarithm of book value of total assets (LNASSET).

5.1.2. Financial distress and leverage.

A significant set of studies centred on non-financial companies argued that excessive leverage contribute to increase a financial distress and gross interest rate exposure. Such increased risk exposure is one of the factors that contributed to higher usage of derivatives by more leveraged companies, as companies that are closer to default have more incentives to hedge. In reference to the banking industry, Sinkey and Carter (2000) mention that an effective hedging program would be more beneficial for highly leveraged banks with greater financial distress. In particular, highly leveraged institutions prefer to increase hedging due higher probability of going bankrupt. Bank's capital structure have also a crucial impact on extent of derivatives usage, as hedging should be highly correlated to the amount of debt in the balance sheet. In support of this logic some studies document an opposite relationship between the extent of derivatives participation and amount of equity capital. However the values may differ in relation to bank characteristics. From one perspective higher capital ratios may witness that derivatives usage is subject to specific capital regulatory requirements that must be achieved by banks in order to able to operate with derivatives. From other perspective, lower level of equity capital as a consequence represents higher leverage and increased probability of financial distress. We expect that more leveraged banks will use more derivatives in order to hedge interest rate exposures.

Consequently debt-to-equity ratio is included as a measure of financial leverage. A positive correlation would suggest that in order to reduce the likelihood of default, banks with higher debt levels will use more derivatives.

5.1.3. Liquidity as alternative to hedging

Liquid assets by definition represent lower risk. Banks that have more diversified balance sheets and have more liquidity in their asset composition are considered less risky. Li and Marinc (2013)[59] explain that liquidity is negatively related with the bank risk because liquid funds help banks to diminish their exposure to credit risk. Goddard and Yener (2005)[60] mention that liquidity can be thought of as alternative for hedging and in order to capture this effect we use liquid assets ratio (LIQUID), which is calculated by dividing a bank's liquid assets by total assets. If actually higher liquidity can signify an alternative to hedging, such banks that have higher presence of liquid assets in the balance sheet will use much less derivatives for hedging activities. However such argument is controversial as banks could instead use derivatives to speculate and still have higher amount of liquid assets.

Higher amount of liquid assets should be negatively correlated with the degree of participation in derivative markets, so we include liquidity ratio as a explanatory variable in the regression model.

5.1.4. Proxy for diversification. Loans to assets ratio

Shiu and Moles (2008)[61] use diversification of revenues to capture the relation to derivatives usage. The Loans-to-Assets ratio (LTA) is a good indicator in order to measure the degree of diversification of the bank revenues. The total revenues of the bank are composed by interest and non-interest income like fees, trading activities and service charges. Even if from historical perspective most of banks revenues have been gathered from investing and lending, higher incomes in non-interest activities can increase revenues when lending activity is less

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[59]LI S., MARINC M., "*The Use of Financial Derivatives and Risks of U.S. Bank Holding Companies*", Forthcoming at the International Review of Financial Analysis, presented at Midwest Finance Association 2013

[60] ASHRAF D., GODDARD, J.A., YENER A., "*Determinants of the Use of Credit Derivatives by Large US Banks*." (June 2005).

[61] MOLES, P., SHIU, Y-M., SHIN, Y-C. (2008). "*What motivates banks to use derivatives: Evidence from Taiwan*." Paper presented at Emerging Markets Conference, London, United Kingdom.

profitable. Banks with traditional intermediation scheme are characterised by higher loans-to-assets ratios as major part of their total revenues come from securities investments and traditional interest revenues from loans. In contrast, banks, which sources of revenue are more diversified and that are involved in activities beyond traditional intermediation like asset management or investment banking have lower levels of loans-to-assets ratio.

Hassan (2009)[62] analyzing US commercial banks find differences among determinants of different types of derivatives and loans ratios (LTA). The author finds significant positive correlation between swap contracts and loan ratios which implies that in order to reduce risk defaults that result from loans banks use more derivatives. In contrast forwards and options are negatively correlated with LTA, so they are used as alternative to tradition banking activities and not lo lower risks from lending.

LTA ratio is included as explanatory variable in the model. We assume that higher degree of diversification is positively correlated with derivatives usage so we expect a negative sign for (LTA) ratio.

5.2. ***R***egression model

In the following section is described the multiple regression model using notional amount of derivatives scaled by total assets (DERIVTA) as a dependent variable of the model. The explanatory variables were selected by comparing the most used in the literature. The regression equation is formulated as follows and explanatory variables are described in the summary table below.

$$DERIVTA_{it} = \alpha_0 + \alpha_1 \, LNASSET_{it} + \alpha_2 DE_{it} + \alpha_3 LIQUID_{it} + \alpha_4 LTA_{it} + \varepsilon_{it}$$

Where α0 is the first parameter of the regression equation that is interpreted as intercept of the regression line. It can be interpreted as the intercept

[62] HASSAN M.K., KHASAWNEH A.Y., "*The Determinants of Derivatives Activities in U.S. Commercial Banks*", Working Papers, Network Financial Institutions, Indiana State University, USA, September 2009

of the regression line and indicates the value of derivatives when all the independent variables are equal to zero, of company i in year t. $\alpha_1, \alpha_2, \alpha_3, \alpha_4$ are the regression coefficients which represent the slope of the line between the dependent and the independent variables. ε is the random-sampling error for firm i in year t and represent the difference between the observed value and the fitted values.

Labels	**Description**	**Proxy for**	**References**	**Exp. Sign**
DERIVTA	Notional amount of derivatives divided by total assets	Derivatives usage	Sinkey and Carter (2000)	
LNASSET	Natural logarithm of total assets	Bank size	Adkins, Carter, Simpson (2007) Sinkey and Carter (2000) Shiu, Moles, Shin (2008)	(+)
DE	debt-to-equity ratio	Leverage risk	Sinkey and Carter (2000)	(+)
LIQUID	Liquid assets to total assets	Liquidity risk	Ashraf ,Goddard, Yener (2005) Li and Marinc (2013) Sinkey and Carter (2000)	(-)
LTA	Loans to total assets	Diversification	Khasawneh and Hassan(2009) Shiu, Moles, Shin (2008)	(-)

5.2.1. Description of the data

As reported on the summary table of descriptive statistics we can rely on an average number of 2763 firm-year observations, with slightly lower number for Debt-to-equity ratio. The numbers show us how sample average bank balance sheet structure is composed. An average bank from the sample have 23,10% of liquid-to-total assets and reasonably diversified portfolio with loans that compose

52,95% of total assets. An average debt-to-equity ratio of the sample is 11,47 with the highest observed value (114,15) for Dexia SA in 2008 , however the leverage ratios are significantly high for most of the large banks like Barclays Plc, UBS AG and Deutsche Bank AG.

Table 13 : Summary and descriptive statistics of the variables for 2000-2013

Variable	Obs	Mean	Std. Dev.	Min	Max
DERIVTA	2763	.0398433	.0998519	0	1.092483
LNTotAssets	2763	15.40376	2.726289	4.958152	21.67365
LTA	2763	.5295054	.2530952	0	.9608807
DebtEquity	2708	11.47876	8.963309	.1086321	114.1553
LIQUID	2763	.2310203	.1879225	.0009862	.9986283

Source: STATA, ***summarize***

To check to evaluate whether or not there is the evidence of linearity among our response and explanatory variables, both pairwise correlations and variance inflation analysis were implemented. As from the summary table below, Variance inflation factors test for collinearity gave sufficient confirmation to conclude that collinearity is low. Different studies mentions that collinearity may be an issue for the range of 5-10 VIF and higher. In our case the coefficients are significantly lower with an average of 1,54, consequently the variables can be used to run the regressions.

Table 14 : Collinearity diagnostics for the variables

Variable	VIF	SQRT VIF	Tolerance	R-Squared
DERIVTA	1.51	1.23	0.6627	0.3373
LNAsset	1.62	1.27	0.6165	0.3835
LTA	1.59	1.26	0.6296	0.3704
DebtEquity	1.48	1.22	0.6735	0.3265
LIQUID	1.50	1.22	0.6685	0.3315
Mean VIF	1.54			

Source: STATA, ***collin***

5.3. *Regression results*

In the present section we will be analyze the correlation of bank-specific accounting measures with derivatives usage in the European banking sector using different regression methodologies starting from pooled OLS (POLS). Then in the following section we will discuss the results and draw the conclusions.

Table 15 : Pooled OLS regression

Source	SS	df	MS		
				Number of obs =	2708
				F(4, 2703) =	343.92
Model	9.25849973	4	2.31462493	Prob > F =	0.0000
Residual	18.1915201	2703	.006730122	R-squared =	0.3373
				Adj R-squared =	0.3363
Total	27.4500198	2707	.010140384	Root MSE =	.08204

DERIVTA	Coef.	Std. Err.	t	P>|t|	[95% Conf.	Interval]
LNTotAssets	.0140325	.0006967	20.14	0.000	.0126664	.0153987
LTA	-.1116564	.0078224	-14.27	0.000	-.1269949	-.0963179
DebtEquity	.0026329	.0002083	12.64	0.000	.0022246	.0030413
LIQUID	-.0038945	.0106182	-0.37	0.714	-.0247151	.016926
_cons	-.1454407	.0119038	-12.22	0.000	-.1687822	-.1220992

Considering the results of pooled ordinary least squares regression in first place it is useful to underline that our dataset provide relatively high R-squared value (33,73%), which demonstrate the accuracy of the model in response to observed outcomes. Centering the attention on the table of coefficients, all the independent variables present high values of t-statistic which generate corresponding small P-values. As a consequence, most regression coefficients are significant at the 1% significance level excluding only liquid assets ratio. However, low statistical significance of liquid assets ratio can be a consequence of ignoring the panel structure of the data by pooled OLS estimator. The reason is that pooled OLS provide efficient and reliable coefficients only if trough the observations there is no time or unit specific differences. In other words, if the change in the dependent variable is due to the period of observation or to a bank-specific observation and not to the change in the explanatory variables.

To face this problem , we use fixed and random effects models in order to take advantage of the panel structure of the data and to account for annual fluctuations in the dependent variable that were caused due to multiple observations over the

Table 16 : Summary of regression results. Pooled OLS versus FE and RE[63]

	POLS	*p-val.*	FE	*p-value*	RE	*p-value*
Dependent variable	DERIVTA		DERIVTA		DERIVTA	
Intercept	-.1454 (-12.22)	0,000	.0300 (1.18)	0.239	-.0692 (-3.51)	0.000
LNASSET	.01403 (20.14)	0.000	.00367 (2.30)	0.022	.0102 (8.60)	0.000
LTA	-.1116 (-14.27)	0.000	-.06946 (-6.02)	0.000	-.0836 (-8.19)	0.000
DebtEquity	.00263 (12.64)	0.000	.00083 (4.56)	0.000	.00104 (5.80)	0.000
LIQUID	-.0038 (-0.37)	0.714	-.0800 (-8.44)	0.000	-.0655 (-7.14)	0.000
Observations	2708		2708		2708	
R^2 within	-		0.0466		0.0413	
R^2 between	-		0.2758		0.3603	
R^2 overall	0.3373		0.2329		0.3052	

years and not due to changes in the independent variables of the model.

In the Table 16 we can compare all three estimators and their results. In fact taking into consideration the bank specific effects, the variable LIQUID became strongly statistically significant at 1% confidence level, while p-value for the size proxy (LNASSET) slightly decreased, still remaining statistically significant at 5% confidence level with (0,022) *p-value*. Independently of the used estimator the

[63] In the table the relative t-statistic values are reported in the parenthesis under coefficients

model provided high R-squared, with slightly lower result (23,29%) for the fixed effects estimator.

The selection of most appropriate estimator was made by comparison tests which results are summarised in table 17. The results evidence that Fixed effects estimator is the most appropriate to examine the dataset.

Table 17 : Summary of results of model selection

T	Specification test	Null hypothesis	Alternative hypothesis	Test Statistics	p-value
1	F-Test	POLS	FE	F=25.44	0,0000
2	Breusch-Pagan	POLS	RE	χ^2=5248.23	0,0000
3	Hausman	RE	FE	χ^2=91.46	0,0000

5.4. *Discussion of the results*

From the results provided in table 16 we can conclude that in general bank size and derivatives usage are positively correlated. This result as expected is supporting the theory of scale economies in derivatives activities. Relying on results of fixed effects model it was possible to obtain a positive coefficient (0,00367) with t-statistic (2,30) and p-value of 0,022, which mean we can reject the null hypothesis in favor of positive linear relationship between bank size and higher derivatives usage. Undoubtedly, risk management or hedging program may have elevated cost of implementation, which create some entry barriers for smaller banks.

Bank's leverage was the second financial characteristic that was analyzed. We have obtained strong evidence that higher debt-to-equity ratio as a proxy for financial distress is positively correlated with derivatives usage. In instance, this result can be reasonable, as highly leveraged institutions prefer to increase hedging due higher probability of going bankrupt. From this perspective, lower level of equity capital as a consequence represents higher leverage and increased probability of financial distress, consequently more leveraged banks are using more derivatives in order to hedge interest rate exposures and reduce the likelihood of default.

Liquidity ratio has proven to be statistically significant for fixed and random effects models with significant coefficient at 1% confidence level and high t-statistic. The negative sign of coefficient in line with our expectations confirms that for European banks in the sample liquidity can be thought of as alternative for hedging. In fact, observed banks with higher ratio of liquidity to total assets use much less derivatives, including derivative for hedging activities. From the obtained results we can conclude that in general, banks that are substantially involved in derivatives activities have much lower liquidity in their balance sheets, conversely banks with higher amount of liquidity use much less derivatives as liquidity is considered as hedging substitute.

Ultimately, coefficient of loan-to-asset ratio (LTA) is statistically significant across all regression methodologies. In particular for fixed effects model we have found coefficient to be negative (-0.069) with high t-statistic (-6.02) and significant at 1% level. Considering that LTA was considered as a proxy for the extent of diversification of assets, we can conclude that banks with higher derivatives activities are more diversified. In fact, considering negative sigh of coefficient, less diversified banks with higher LTA have much lower involvement in derivatives activities. In contrast banks with more diversified sources of revenue and that are involved in activities beyond traditional intermediation may use derivatives as alternative to tradition banking activities and not only lower specific risks. Consequently higher degree of diversification is positively correlated with derivatives usage.

Chapter 6. Conclusions

Analysing last twenty years of the evolution of financial markets it is impossible to ignore such rapid growth of derivatives usage by almost any type of company, both financial and non-financial. Participation of financial institutions in the derivatives market had been growing almost unstoppably till 2008 financial crisis. However, even if after the crisis the gross market value of derivatives contracts declined, for some types of contracts exchange by nominal amounts continued to expand. Different financial instruments like options, futures and swaps nowadays constitute an important part of bank's balance sheets. For the reason that most of derivatives markets are dominated by banks, especially after the 2008 financial, crisis their involvement in such markets are increasingly debated and remain a major issue for financial regulators.

In order to deepen understanding of the role of banks in the derivatives market and to analyse and the impact of such instruments on banks performance and risk we analysed the sample of European listed banks. The study attempted to investigate the relationship between financial derivatives and systematic risk in the European banking sector. For such purpose we used the notional amounts of derivatives obtained from Bankscope database by using a sample of 261 banks with highest market capitalisation. Due to database limitations, it was not possible to distinguish between different types of financial derivatives. However, after the analysis of derivatives market in Chapter 1, we can conclude that Interest Rate derivatives (IR Swaps in particular) constitute the major part of this financial contracts, besides most of the examined financial literature reported also that Interest Rate Derivatives were positively related to the market risk.

In Chapter 2 were examined and summarised the main findings in the literature. Subsequently in Chapter 3 was represented a brief description of the data the research method was discussed, in particular which control variables were included in the regression model and why.

The regression results and summary tables are presented in Chapter 4. To obtain more robust results and for comparative purposes, were used different reference indexes for calculation of the systematic risk (β). In particular were used two different benchmark indexes STOXX Europe 600 index, STOXX Europe 50 and lastly multi-index method was implemented, calculating Beta to bank-specific local indexes.

After examining several regressions, we find strong empirical evidence in order to reject the null hypothesis. In fact the coefficient of DERIMV is statistically significant for all reference indexes. The simple OLS provided high explanatory power with range of R^2 from 19% to 26,46% depending on selected reference index and control variables.

Ultimately, the panel structure of the data was considered by performing tests in order to verify the possible improvements over pooled OLS. Both executed tests for fixed and random effects resulted positive. Both fixed effects and random effects model provided results in line with pooled OLS for the variable of interest DERIVMV. On the basis of obtained results we can conclude that for the examined dataset there is positive linear relationship between usage of derivatives and systematic risk of the banks.

The most relevant accounting predictors of systematic risk were size, loan loss ratio and debt to equity ratio. The coefficients of this control variables remained significant with 1% confidence level across different estimation models and reference indexes. Even if other control variables of the model were statistically significant, the major explanatory power of variation of Beta was given by the bank size given by natural logarithm of total assets. The size coefficient is positively correlated with systematic risk independently of reference index and estimation methodology. This explained that even with higher diversification opportunities, the larger banks have higher market risk exposure.

In conclusion, Chapter 5 provide more detailed analysis of the main motivations of the banks to participate in derivatives market. In particular we analysed specific accounting characteristics of the banking institutions that are more involved in derivatives activity. We can conclude that banks with major derivatives usage are larger in amount of total asset under management, have higher degree of leverage, less liquid assets and are overall more diversified.

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